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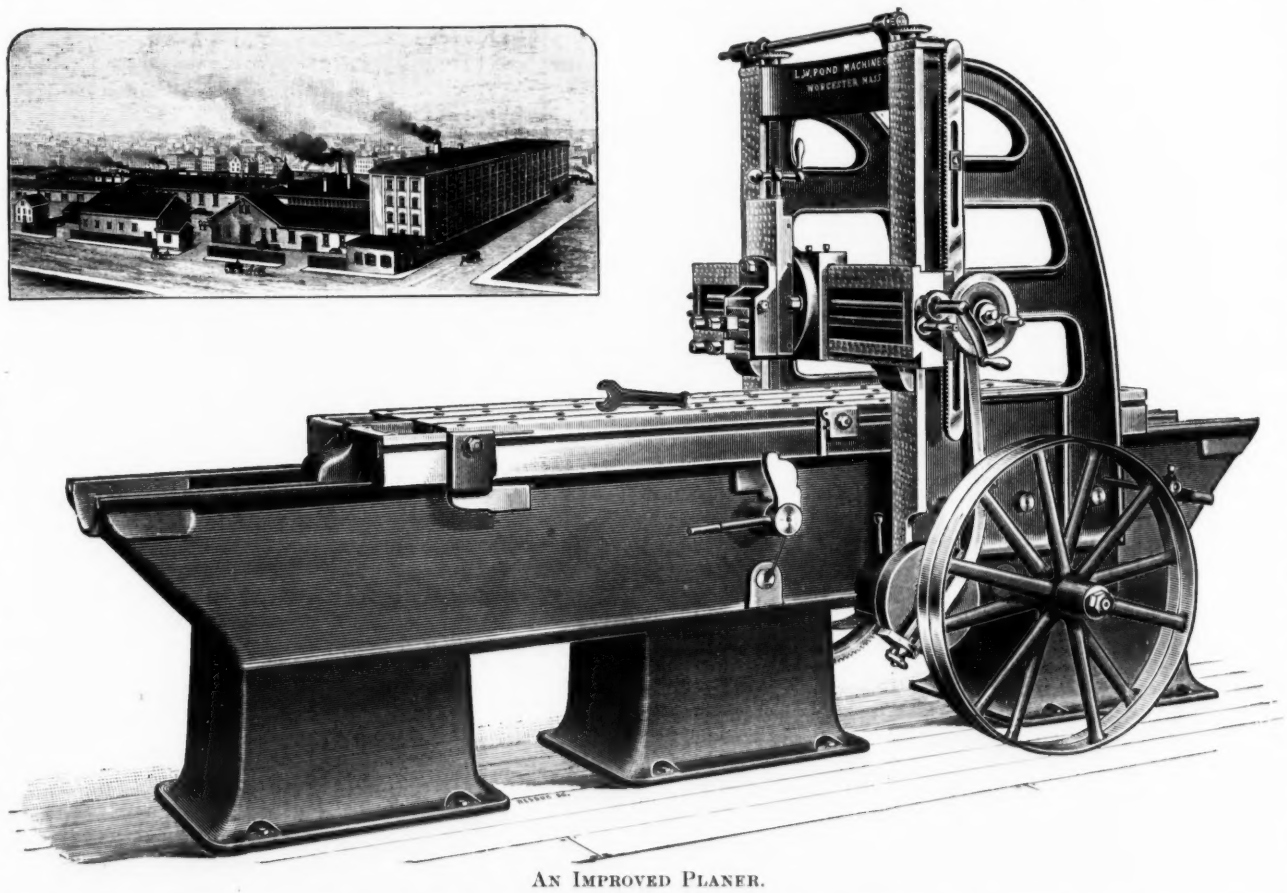
An Improved Planer.

We illustrate herewith an improved planer—the latest production of the L. W. Pond Machine Company, Worcester, Mass.

As will be perceived by those who are familiar with the planers heretofore built by this company, the present machine differs essentially from them in a number of points, notably in the proportioning of the bed and method of supporting it, besides which there is an improved system of gearing, by which a return motion is given the platen of 5 to 1, and yet the smoothness of action is preserved; in fact, the reversing of the platen is accomplished as smoothly and quietly as was the case with the previous machines having a backing speed of 2 or 3 to one only. All the gears of the driving system are placed within the bed, the bearings for them being bored by the use of jigs which rest in the Vs, thus insuring accuracy and interchangeability, while the shafts are bushed with eccentric sleeves by means of which the finest adjustment or "depthing" may be secured.



AN IMPROVED PLANER.

An improved feeding device has been put on this machine, by which feeds from the finest ever needed to 1½" are readily obtained, and by changing the crank from one stud to another at the end of the cross-rail the head can be run across the rail at four times the ordinary speed, thus saving time and labor.

The pulleys and gearing are so proportioned as to give a very high belt speed, thus making the belts easily shifted and giving great driving power. The engraving was made from a 24"x6-foot machine, but fairly represents the improvements made in the 28", 32", 38', and on up to 72", with any length of bed desired.

We have before mentioned the fact that this company has been building new shops, some idea of the appearance of these being obtainable from the engraving.

Hardening Steel Dies.

BY B. F. SPALDING.

Hardening blocks of steel, like drop dies, which are nearly cubical in form, frequently results in bulging of the centers. Investigation may reveal the cause. If the matter is examined for the purpose, and attention especially directed to it, the reason why this effect is produced may be discovered, and when this is ascertained it will be known whether any measures can be taken to guard against the injury, and if so, what these measures may be. Not only are hardened blocks liable to get bulging, but blocks planed flat on their faces and carefully annealed will be affected more or less in the same manner.

The heating of steel expands the spaces between the particles, and possibly the particles. Let us take a piece and say that it is heated uniformly, and that when thus heated it retains its original relative proportions. If it is a cube with six flat sides it will remain a cube with the sides as flat as before; this can be plainly demonstrated, but it is not necessary, as a very slight consideration will make the truth of the proposition apparent. If this evenly heated and still plane surfaced cube is suddenly plunged into cold water, the first effect of the cooling will be felt and exhibited on the corners and along the edges, because on the corners the water has access to, and carries away the heat from three sides simultaneously, as is shown in the illustration, Fig. 1, page 2. It is plainly to be perceived that the very point of the corner *A*, *B*, *C* will be cooled, and consequently contracted almost instantly, and that the cooling is carried on with two thirds the means along the edge *A D*, as also along the other similar edges *E B*, *C F*, for the water has access to them from only two sides instead of three, as at the corner.

Let us suppose the cooling is not constant, but in steps; that it cools a depth of ⅛ of an inch at each step. It will cool on the whole surface of each side an eighth of an inch at a step, but at the edge (see Fig. 2) there is twice the cooling power exerted, as the heat is carried from the top and the side, and as either would cool off the square eighth at the vertex of the angle, then as much of the cooling power as would cool off another equal square is left free to cool off more of the contiguous metal, so that the strata or layers of metal cooled will assume the shape shown in Fig. 3 at the edge, which is the same as though we had taken two plates of iron, ⅛" thick, square across the end, and driven back the stock on one edge of each, until its cross-section showed an angle of 45°, so that they would miter when put together, and form a square corner. These two plates represent two sides, but when the cube is cooled by submersion in water, it must be cooled on at least three sides—which can be done by dipping the corner down—so to represent this third side there is to be another plate go on, and its joint would have to be mitered, which would drive the stock farther back at *B*, Fig. 3, which is the same thing as saying that another extra amount of cooling power is left free at the corner to cool the piece still deeper there than along the edge.

The heat which the block contains all went in from the six sides: these were the gates of entrance, and they must also be the gates of exit. None of the heat got in except through the outer surface, and it must get out through the same paths by which it entered; it must be handed along from particle to particle in all its journeyings, and can only travel as fast as these particles pass it along to each other. A trace of carbon in these particles may slow their action, and manganese, it is feared, may make them quite lazy, but whether active or indolent they must pass all the heat out through the passageways of the surfaces.

With these facts in view it becomes more apparent that if this heated cube is suddenly plunged into cold water, the first effects of the cooling must be felt and shown at the corners, because three surfaces meet there, and supply three doors for the heat to escape. Referring to Fig. 1, it will be seen that the heat escapes from *A*, *B*, and *C*, at the corner, and two-thirds as fast from the edge, where it can get away through *A G* and *C F*, the upper and side surface; and that any point which lies in such a position as to be cooled from only one surface will be affected by the exit of the heat only one-third as fast. In fact, the cooling, acting from the outside, affects the particles in like manner as abrasion in a tumbling barrel. If you rattle a cube in a tumbling barrel long enough it will wear or be worn to a sphere. Sometimes in hardening a piece having a square corner this corner cracks off in a shape similar to that it would be worn to in a rattler.

Now as the cooling power is exerted along the edges with double the force that it is at a point where it is affected from only one side, the contraction along the edges must take place more suddenly. In order for any part of the metal to contract, it is necessary that the adjacent metal shall contract with it, or be indrawn together by the contraction. In the shrinking of the edges they are subjected to so great a stress as to open any checks which may be in them, but if there are no checks it is seldom that cracks start. The extreme edge has its heat conducted away so rapidly that the shrinkage is capable of moving with sufficient speed the adjacent particles all that is necessary to prevent excessive strain before the adjacent particles also shrink and help to carry the process along. But if we could examine the strain all along the side of a cube which has been hardened—say on the dotted line on Fig. 1—we should find it to increase in an accelerated degree as we approached the edge, and still more so as we neared the corner.

As the cooling of the cube constantly progresses from the edges there is a diminution of the rate of cooling, and the power of contraction to move the adjacent particles is weakened; there is not so large a relative proportion of the mass at once affected from the two sides, and there is more of the mass resisting the shrinkage, the compressive force is less and the resistance greater. The surfaces cool and contract, while the interior remains hot and expanded. There is a red-hot ball inside of the inclosing cube. This cube has surfaces which have conformed their shape to accommodate the expanded interior, and when the hot ball shrinks it will do so from these hard and set confines on lines growing softer as they converge to the center. It is evident that as the shrinkage pulls on these lines they will give way and be drawn apart in the weakest place, and as they cannot move the strong cooler arched surfaces, they will be strained to loosen some degree of their cohesion towards the weak center. This appears to be the mode of operation of the causes which act in hardening

cubic blocks to make them bulge in the center, and the remedy must be found in some means of cooling the center first. The same causes which produce the bulging, also produce unequal strains throughout the mass, and all of these difficulties would be in a great measure overcome if the block could be brought to just that condition of uneven, but regulated heat at which the outside should be so much hotter than the inside, that when the block was quenched in the water the power of the metal to conduct heat would act so speedily throughout the block as to bring the whole mass to an equal temperature at the instant when the temperature coincided with that necessary to fix the carbon in its combined state, and harden the block. Either of these remedies is impracticable; nor does the nature of the case appear to admit anything as a remedy which will guarantee positively good results. An amelioration of the evil is all that can be looked for. Any hope that a piece of steel will go unaltered through the process of hardening is baseless.

If steel could be instantaneously cooled throughout, it might escape deformation in hardening. As the heat must escape from particle to particle, the quicker it flies from one to another, or, in other words, the greater the conductivity of the metal the quicker it parts with its heat, and the better it will harden. It takes some time, not a great deal, but a little time for the carbon—which, when the steel is hot, is diffused and combined with it—to get away from it into separate cells. The reason why soapy water will not harden steel is because it does not make contact with it, and convey away the heat quick enough to catch the carbon in its combined form before it separates from its union, and takes a form of its own.

Why is it that heat makes steel what we call soft, so that it works easily under the hammer? It is because, under its influence, the lines of cohesive force cease to be rigid; they yield, and permit flow. If water is put into a tight hollow cylinder, and a well-fitted piston forced down upon it, it is no more yielding than steel, as long as the cylinder holds tight, but let the cylinder be made of rubber, and there will be a yielding before the piston, in proportion as the cylinder yields so in steel; as the cohesive attraction which binds the particles together is loosened, it yields or gives way under a blow by flowing in the direction of the least resistance.

Perfectly hardened steel is perfectly elastic; there is no more flow to it than there is to quartz. In hardening, if steel was a perfect conductor, the heat would immediately fly out from its interior the instant the surface came in contact with an ample supply of water, the lines of cohesion would instantly become rigid, uniform contraction would ensue, the carbon would be caught in the act of union, the steel would be hardened clear through, and it would not be bulging or cracked. It is, therefore, evident that any element which is introduced into steel which reduces its power to conduct heat, whether by forming hybrid molecules, or by coating the atoms with films, or by blocking the passageways, detracts from its value as hardening steel. The steel thus injured may harden well on the outside, but will not harden in deep, and in drawing the temper will lose too much of its hardness for a slight change in color; in some of it the hardness all seems to be gone when the color is only a straw.

In the blacksmith shop the principal blocks to be hardened are dies, to be used for shaping work, either in the drop or trip hammer. There is very little trouble with the trip-hammer dies, and in many instances the swelling of the center does not materially injure the drop dies, especially if the impression is central and not so large as to be affected by the convexity. In long impressions as in dies 12″ long, the curve or bowing of each die will sometimes amount to a sixteenth of an inch, and quite often to a thirty-second, and when this difference is doubled, as it is when the dies come together, it produces a very perceptible variation in the thickness of the pieces thus dropped, the ends being too thick for the center. When reasonable effort has failed to harden such dies so that they will be straight enough to produce acceptable work, they may be worked over in the light of experience, and the impression deepened in the center to such a curvature as will probably produce straight work after the die is deformed by hardening.

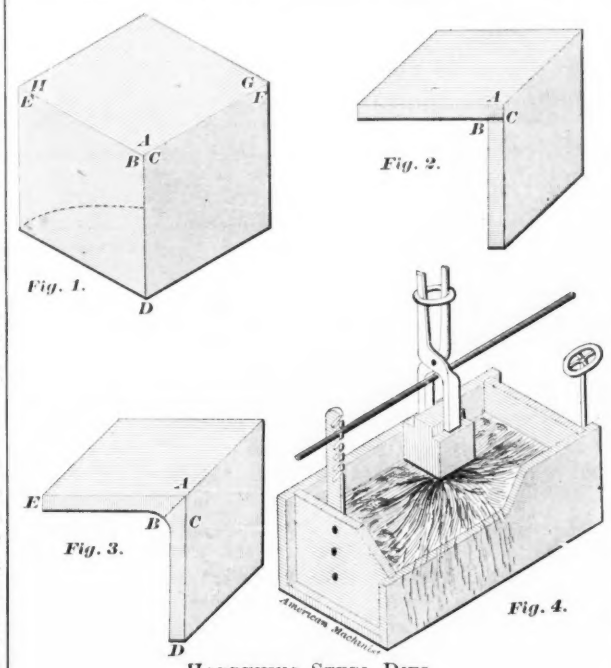


Fig. 1. Fig. 2. Fig. 3. Fig. 4.

HARDENING STEEL DIES.

Some parties using drop dies are so heedless or so reckless that they will let a pair of hardened or even soft dies strike together with nothing between them. This is exasperating to a die sinker, who has, perhaps put a week of his best work into them; he has got his pay for them, but still he has some respect for the creation of his own hands. When convexed dies are thus struck together they are damaged around the impression, while if the dies were flat or the least concave they would take the blow on a die to prevent the bulging, as much as possible, is to heat it evenly to a temperature as low as it may be safely trusted to harden, but to be certain that it is hot enough so that the operation will not have to be repeated. The water should come into the tank from below, and rise above the surface in the form of a low cone. The die may be made fast in a pair of tongs, and adjusted so that it can be held steadily over the water at just the proper height. All the adjusting can be made before the die is heated, so that when it is hot everything will be ready. The die may be left with the water coming up against it until it is cold, or until it is cool enough to submerge, and left to get thoroughly cold; or it may be taken when it has ceased to sizz, and hustled into a quick-heating fire, and kept in constant motion until the outside is surely heated hotter than the interior. In exceptional cases, in the hands of a bold and skillful expert, this latter method of handling may correct, to some extent, the bulging caused by hardening. Its object is to raise the temperature of the outside above that of the interior, to relieve internal strains.

Designing Castings, Formation, Crystallization and Shrinkage of Cast-iron.

BY JOS. P. MULLIN.

The papers by Mr. Bolland and Professor Joseph Torrey in recent issues of the AMERICAN MACHINIST have been both interesting and instructive. Truly "the question of the physical properties of iron and steel as related to its chemical composition has been a fascinating one," and for this reason much has been written concerning the chemical composition of cast-iron, while another vital point in the "art of molding" has received but little attention from scientific authorities.

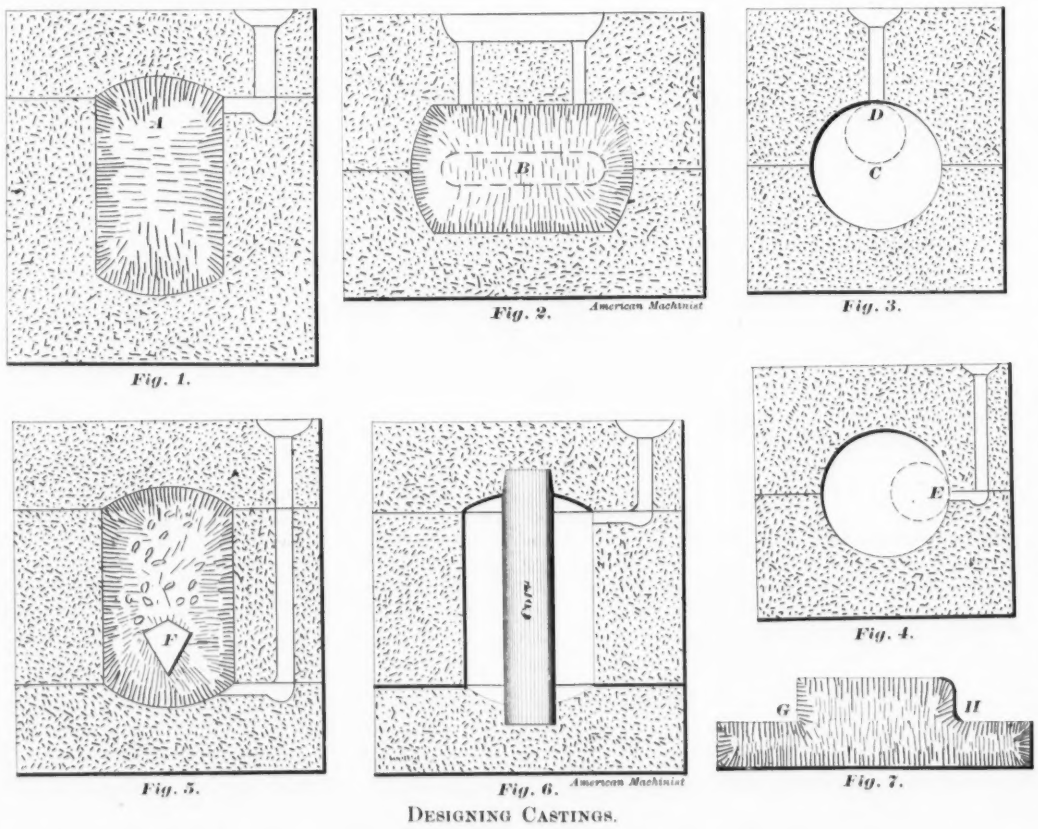


Fig. 1. Fig. 2. Fig. 3. Fig. 4. Fig. 5. Fig. 6. Fig. 7.

DESIGNING CASTINGS.

The study of the formation, crystallization and shrinkage of cast-iron is, however, quite as attractive as the diligent pursuit of "the science which shows the nature and properties of bodies," and may enlighten us on many facts which cannot be clearly illustrated by chemical analysis alone.

Cast-iron being one of those crystallizing bodies, which in the act of cooling or consolidating in a measure obey certain natural laws—according to circumstances—it may, therefore, be safely enunciated, that while so solidifying or changing from a molten to a solid state, these crystals form themselves perpendicular to the surface or boundary line of the casting; in other words, they are grouped perpendicular to the external contour. Consequently, in designing castings it is all important to so arrange their general outlines as to least interfere with the natural laws governing the formation of these crystals. In fact it is a matter of vital significance that those who have to design castings which require strength and solidity, or which may be liable to sudden jars or changes of temperature, or which may have to stand any considerable hydrostatic or steam pressure, should thoroughly understand and observe the natural laws of crystallization and shrinkage of metals, more especially cast-iron and brass, as it is to these metals that the molder has most frequently to direct his attention and exercise his practical knowledge.

Crystals of cast-iron arrange themselves in the direction in which the heat has passed outward from the metal while cooling, and in proportion to the rapidity and regularity with which the heat has been extracted or absorbed these crystals are apparent, as in the case of "chilled" iron.

In car wheels, for instance, the crystals are often found penetrating to the depth of an inch and one-half or more into the substance of the metal, and present a clear and perfect development of crystalline structure. Thus it is in designing castings that it should always be carefully considered in which way the lines of crystallization flow, and the outlines or conformation of the casting should be made in such a manner as to allow the lines of crystallization to produce the most compact form, in order that the molecules may not become separated by the influence of any unnatural force.

Having thus briefly delineated the probable process of crystallization and shrinkage of cast metal, let us trace its effect upon a few different forms of castings.

When molten metal of any kind has been poured into a mold the outer part, or that part which comes in immediate contact with the mold, cools and solidifies, while the inner part remains, for a time, in a liquid state; consequently, the outer part, by becoming firm before the inner part, causes the casting to occupy a larger volume than it would have done if all parts had been cooled uniformly. It therefore follows that there must be a deficiency of metal—which is surely a point of weakness—in some part or *parts* of the casting. Let us endeavor to locate this weak point in some different configurations of molds.

As we have stated, the outer part of the mold cools and becomes rigid, while the central portion of the metal is yet fluid and hot; therefore a time will arrive when the solidified walls of metal, in the upper parts of the mold at least, will no longer remain in contact with or receive any additional supply of fluid metal, and the latter will, of course, sink away as the temperature decreases, owing to the natural laws of contraction and gravitation. Hence it is, if a mold is filled in the position shown at Fig. 1, a porous shaft, if not a real cavity, will be found in the upper part of the casting as represented by *A*. If we set this same piece horizontally and cast it in the manner shown at Fig. 2, it would appear that the point of weakness would be located about the center, and extend very nearly the whole length of the mold as denoted at *B*. This, however, cannot occur, for the reason that the metal that first comes in immediate contact with the bottom part of the mold will be first cooled, and the continual infusion of fluid metal liquidates the shrinkage and tends to prevent the formation of cavities. In fact, we may say that the force of

gravity causes the molten metal to flow in and fill up any cavities that may have formed in the lower half of the mold, and, as a consequence, when the mold is filled and the metal has set, we may expect to find the first cooled and solid metal situated between the walls of the mold and the dotted line *C*, while the porous part, and perhaps a cavity, will be located above the center, somewhere about *D*. If we allow the mold to lie in the same position, and change the manner of feed to that which is shown in Fig. 4, the result will probably be a change in the location of the caverned part of the metal, from *D*, Fig. 3, to the vicinity of *E*, Fig. 4, which would make no material difference in the strength of the casting.

If we return to the vertical position and instead of casting it from the top, as described in the first illustration, we cast it from the bottom as shown in Fig. 5, the hottest metal will then be in the lower part, and the colder metal in the upper part of the mold, and, as a consequence, the principal defect will be found somewhat nearer to the lower end then it would have been if the metal had entered the mold at the top. I have seen a casting 9½" diameter by 22½" long made in this way, and while the outside to the depth of 1½" was practically perfect, the inside not only contained the large cavity *F*, Fig. 5, but the whole mass of metal was literally "honeycombed." This was probably caused by the metal on the outside of the mold becoming crystallized and solid, while the inside remains for a time in a liquid form, and perhaps in a state of agitation, and the gas evolved during this period of confusion is imprisoned by the outside crust, and in all likelihood diffuses itself throughout the whole mass.

If this line of reasoning is correct, then it is evidently very difficult, if not absolutely impossible, to avoid these defects in solid balls, or cylinders of cast-iron, of any considerable dimensions. But it is also evident that its influence on the strength and quality of the casting can be considerably modified if not completely annulled.

If we investigate the action of cast-iron in the mold immediately after casting (which can be done by covering a part of the mold with a sheet of mica), we will see that the metal which first comes in contact with the sides of the mold moves upward with a concentrical rolling motion, while the top surface is disturbed by a slight bubbling. This action lasts only a little while after the mold is "up," the outside cooling and soon forming a crust or "skin" with a perfect crystallization and a proportionate strength of metal.

From these facts it is clear that, in designing castings which require strength and solidity of metal, it is important to so arrange their general outlines as to present all the cooling surface practicable. And so it frequently happens that we can take such a casting as the one represented in the foregoing illustration, and by coring it, as shown in Fig. 6, we reduce the weight and secure a corresponding increase of strength.

Abrupt alterations in the thickness of metal in the same casting are highly injurious, and should, in all cases, be avoided, since every sudden change and every angle, no matter how slight it may appear upon the exterior of the casting, is accompanied by an equally sudden change in the arrangement of the crystals of the metal, and along the line of junction of these crystals will be found a line of weakness corresponding with the plane towards which the heat has passed outward from the metal while cooling. It is, therefore, evident that if, instead of the abrupt angular change of form shown at *G*, Fig. 7, the curved form *H* be adopted, when possible, the principal axis of crystallization will also assume the curved line and their destructive tendencies be considerably modified.

In this paper I have confined myself to the simplest forms of castings, and endeavored to point out the probable line of crystallization and the defective results, and to show how its destructive influences may, in a measure, be averted by a little forethought in the drawing office.

A press dispatch from Montreal says:

A curious craft, with an interesting history, arrived in port to-day, on her way to Chicago. The Progress, which is the name of the curious vessel, is an old whaler. She is of 358 tons burden, and was built at Westerly, R.I., in 1843. She was christened the Charles Phelps, and was owned by Charles P. Williams until 1861, when she was sold to the United States government for a store ship, and was used as such during the civil war. In 1865 she was sold by the government at auction, and became the property of William O. Brownell, of New Bedford, Mass. She was fitted for the Arctic, under command of Capt. James Dowden, and continued in this business until she was laid up.

The Progress was one of the five ships which in 1871, at the time of the memorable disaster to the whaling fleet in which thirty-three ships were abandoned, brought back 1,200 officers and men belonging to the wrecked vessels. At one time she was in the ice floes for forty-six hours, and her commander expected her to be crushed to pieces. The vessel proved a profitable investment for her owners during one voyage of five seasons to the Arctic, clearing over $200,000 for them. She has been laid up at New Bedford for the last ten years, but is still a staunch, seaworthy vessel. As she stands now the Progress is fully rigged and sparred. Her water line is painted brick red, and her deck house, boat house, and davits are painted white. Her cabins and state rooms are thoroughly renovated and grained in oak. She is supplied with a complete whaling equipment, and will be exhibited at the World's Fair, so that people of to-day may see what manner of craft the hardy mariners of fifty years ago were in the habit of sailing the Arctic seas.

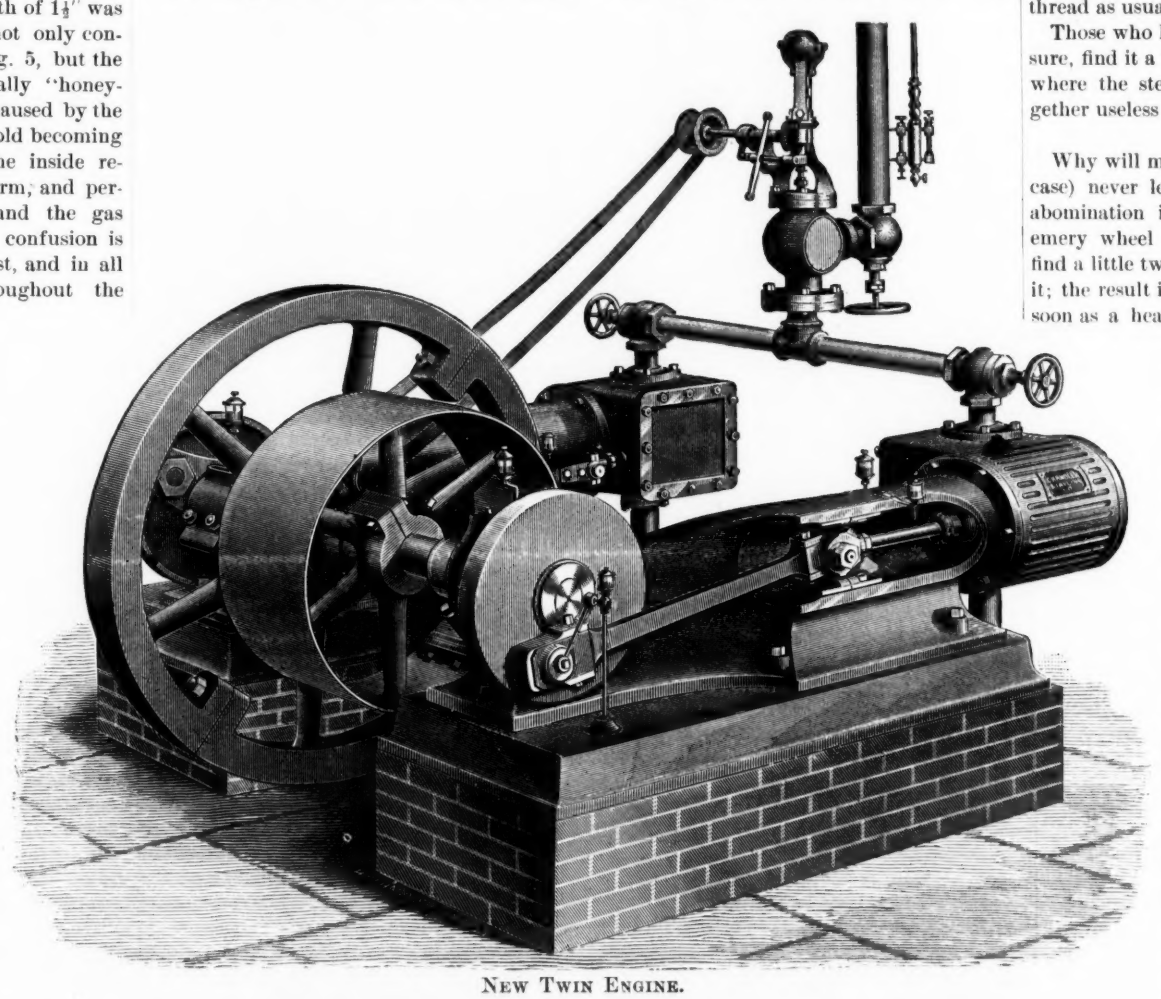
Among the many articles on board are whale fins obtained by a captain who was lost in the terrible disaster of 1871, Polar bear skins, and a valuable set of pictures taken by a man who was in one of the ill-fated ships and was saved and carried eighty miles across the ice to the vessels in open water. The old vessel is at present commanded by Capt. Gifford. She will go into dry dock here to have her keel taken off, so that she can pass through the canals.

New Twin Engine.

The engine illustrated herewith has been lately put on the market by Chandler & Taylor Co., Indianapolis, Ind. The engraving is of an engine built for L. A. Thompson, and is to be used on the Switchback Railroad to be operated in Jackson Park, Chicago, during the continuance of the World's Fair.

The arrangement consists of two engines, a right and a left hand, coupled quartering, with crank disks on the ends of shaft, dispensing with outboard pillow blocks. As is well known, only a moderate sized fly-wheel is required with this type of engine, and for many uses, as where great regularity is not required, this may be dispensed with, the turning still being uniform enough for the purpose required. The working strains are also more equally distributed than with a single-cylinder engine.

This engine, it is claimed, is so constructed as to admit of high rotative speed when desired, as in electric light plants, and for other purposes.



NEW TWIN ENGINE.

To render unnecessary the removal of the crank disks (which are both permanently fixed), the band-wheels and eccentrics are made in halves; this saves work and avoids the possibility of "throwing out" a crank in the operation of removing and replacing a disk.

The governor is placed at the center of the connecting pipe, and there are valves for shutting off either engine without affecting the other. When desired, these engines are fitted with link motion.

A recent Boston dispatch says: About 11 o'clock last night two electric cars in widely separated parts of the city were struck either by lightning or by the motor current through burned out insulation, and several passengers were hurt in the rush to escape. On car 2,046, which was struck in Tremont street, between Concord and Worcester streets, fourteen persons were injured by being bruised or shocked. In car No. 2,058, which was struck in Hanover street, near Cross, Mrs. Annie Collins, aged 50, was bruised and cut on the face, and her right arm was fractured. Two other passengers were severely injured. The injured on both cars were attended by neighboring physicians, and taken to their homes in carriages.

A Few Shop Notes.

BY FRED HERBERT COLVIN.

It quite often happens that, after we have a tap blank forged out and annealed, we find upon attempting to cut it that it is as hard as though it had not been annealed, or, at least, so it seems. But even where the steel has been well annealed and cuts fairly well, *i. e.*, easily, it will often improve matters to have it annealed the second time. We cannot always spare the time for this, but it will pay if we have the time, for it softens the steel considerably, and makes the job of cutting the thread all the more enjoyable. The idea was first broached to me by an old blacksmith, and whenever I have the time I find it quite a help, as well as a saving of tools. After having it forged and annealed, center it, turn it up rough, and then have it annealed the second time, after which ream out the centers to be sure they are true, and finish the tap blank, then proceed to cut the thread as usual.

Those who have never tried this will, I am sure, find it a relief in many cases, especially where the steel is very hard, and not altogether useless with steel of ordinary softness.

Why will men (the shop managers in this case) never learn that a narrow belt is an abomination in general cases? Here is an emery wheel that does hard work, and we find a little two-inch belt attempting to drive it; the result is that the speed slacks down as soon as a heavy piece of work is put on it, and it needs re-lacing very often. Generally speaking, the belts can hardly be too wide, within reason, of course, and the wide belt will be found to give the best results every time. The ideas of economy that we see displayed in so many cases in connection with belts give one a poor impression of the ability of many shop managers; it must be from lack of thought on the subject. The cost of a new belt when needed is far less than the time of the attendant when engaged in patching the old one.

It is no easy task to use a blow-pipe of the ordinary construction for any length of time, as the expenditure of so much breath as it necessitates is weakening unless the lungs be exceedingly strong. If you have much of it to do, rig a little fan, or run a pipe from the air compressor pipes if you have one around the place, and then make life endurable in this respect. But if you have neither of these at hand, you can do very good work with a simple substitute. Of course you have a Bunsen burner for tempering small work or for similar purposes. Just attach this to the end of your hose, and you can swing the flame wherever you choose, and manipulate it just as you do the blow pipe. It will not give quite as hot a flame, perhaps, as when you use "forced draught," but it will be enough for ordinary purposes, and will be a great relief for the breathing apparatus. Try it, and see.

You may not think it is much of a task to be foreman or superintendent of a factory or other manufacturing establishment, but try it and see, and you will find that it is not the easy job it may seem to the observer. Imagine yourself with from fifty to a hundred men, or even less, and plan out each day's work so as to have work ready for the men as fast as the last job is finished. You must estimate the time it will take this man to finish the job, so the next man can have it in time to start on with it as soon as his present work is completed. You must judge of the

time a man should occupy on a job, and also the cost of material in the same, must know whether he is making it right or not, and whether at his present rate he will get it done in time for shipment according to contract; if not, he must have help on it. When you consider all these features, the responsibility of managing the whole place, and, if the judgment proves faulty, of being solely responsible for the loss, it is not an easy task after all.

No precaution that may save life or injuries should be neglected; it is not only careless, but it is criminal, and besides being inhuman, it is also uneconomical. While this may not be apparent, it is nevertheless true, when we consider the world as a whole and not individually; for by maiming any of the human family we are restricting the number of wage earners and increasing the number of helpless that must be cared for by those who can still work. It is the duty of every one to use as much precaution as possible to prevent accidents, and the shopmen themselves are sometimes as much to blame in the matter as the employers; let all be careful, and the horrible accidents will be less frequent. Belting and shafting are responsible for many of them, and often when it might be avoided by a slight expense for boxing up the dangerous element. Box them up as far as necessary to absolutely prevent accident under ordinary circumstances, and even extraordinary, if possible; it doesn't cost much. Keep your shaft free from the miserable little projections, set-screws, etc., that we see so often on our shafting. The couplings with set-screws waiting to catch the unwary sleeve or apron, and the like, should be relegated to the scrap heap as fast as possible. Machinery can be designed just as well without these monstrosities, and how much better it is to have nothing projecting to be afraid of.

Don't monkey with the tools after they are set the way they are to run by the man in charge of them; he is supposed to know how they work, and if he does not it is his fault, and not yours. However, do not go on and spoil stock when you see they are not working right, but inform him of the fact, and let him apply the remedy. It is no excuse for spoiling stock to say that they are just as he left them, for if you see they are not working right you should either stop working or inform him that something is wrong; if he still refuses to fix them it is his fault and not yours, in which case do as seems best to you. Any good man would thank you for standing idle in preference to spoiling stock; but some men are queer, and knowing the man you work for, you can act according to your judgment in the case.

"I wish that seating tool would cut smooth; it chatters fearfully," was the tail-end of a remark overheard in a shop recently. The seating tool or rose-reamer was liberally supplied with soap and paper to fill the teeth and prevent chattering, but was not entirely satisfactory. The paper and soap will help, but the best help is in cutting the teeth correctly. By correctly I do not mean *evenly*, for that is probably the way they are cut at present, but space them as irregularly as convenient, and see if there is not an improvement. The first machine-cut files did not give satisfaction, from the fact that they chattered badly, due to the teeth being cut evenly, while the hand-cut files were spaced by the eye, and consequently not exactly even; this is remedied now, so that a man can hardly pick out a hand-cut from a machine-cut file, and the trouble has disappeared also. Try cutting the teeth unevenly, and not having them too sharp, and see if it isn't an improvement.

A device for enabling a locomotive to ascend steep gradients with a train of cars has recently been patented and a working model exhibited at the offices of Messrs. Pocock & Co., 64 Cannon street, London. The arrangement consists of a grooved drum, which is fixed upon the axle of the driving wheels of the locomotive, and which is of sufficient width to allow of a wire rope being passed once round its circumference. The drum is of the same circumference as the driving wheels, so that at each revolution of the latter the former travels a complete revolution over the cable. This cable lies in the center of the track and is secured at both ends, being thus held taut and taking a grip on the drum. It is maintained in a central position around curves by means of guides. The model climbs easily a gradient of one in three and takes a sharp curve. The ordinary precautions will be taken to guard against accident from the breaking of the cable, such as using powerful brakes, although it is held that the wear and tear on the cable will be reduced to a minimum, so that the risk of accident will be small.—*London Times.*

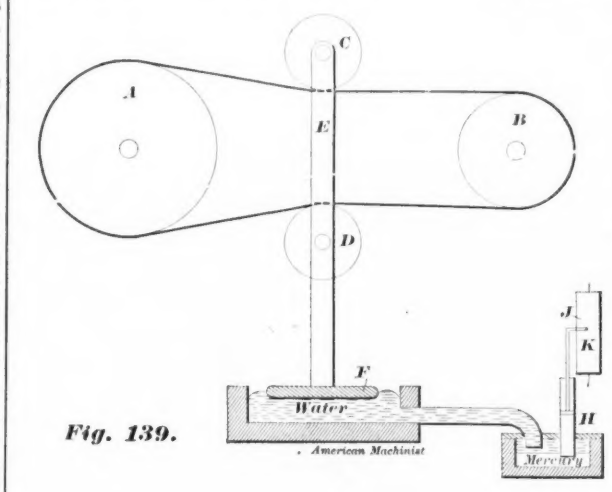


Fig. 139.

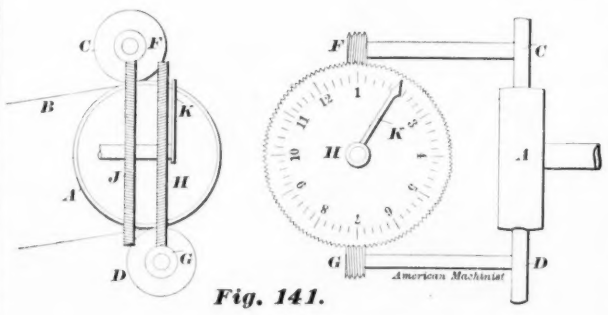


Fig. 141.

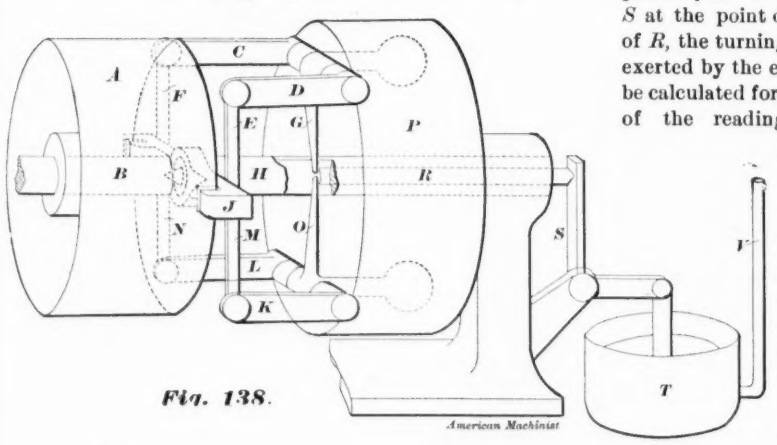


Fig. 138.

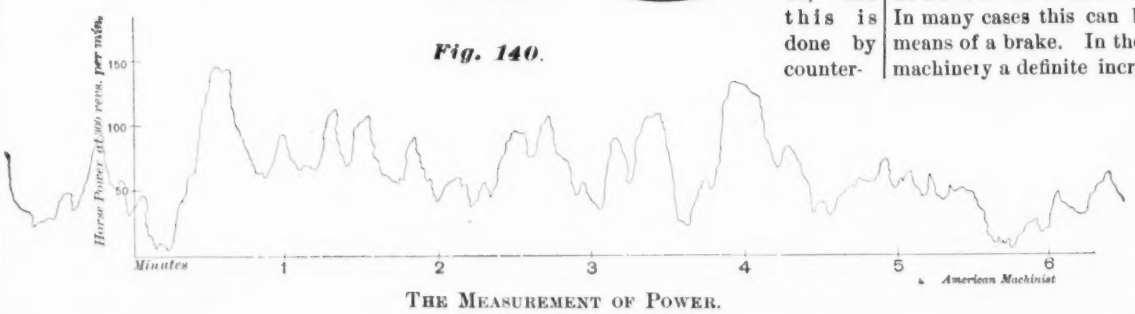


Fig. 140.

THE MEASUREMENT OF POWER.

The Measurement of Power.

BY THOMAS GRAY, TERRE HAUTE, IND.

(A Paper presented at the San Francisco Meeting of the Mechanical Engineers.)

One of the most important, and at the same time most troublesome, problems in mechanical engineering is the measurement of the power produced by a motor or given to a machine. In this paper a brief description is given of the principles of three forms of dynamometer which have been used for this purpose with fairly successful results.

I. Fig. 138 illustrates a form of dynamometer which may be used either to measure the power given to any machine, as, for instance, a dynamo, or to measure the total power given out by an engine which is driving a number of machines. Suppose that B is the crank-shaft of an engine. A crosshead such as, for a different purpose, is here represented by J, is keyed to the shaft, and the pulley P, which in this case is the driving pulley, is connected to the shaft by means of four links, E, M, F, N, connecting the crosshead to a pair of double bell-crank levers, KLO and CDG, mounted on bearings fixed to the pulley. The ends of the arms O and G bear against one end of a rod R passing along the axis of the hollow shaft of the pulley. When the shaft B is turned, two of the arms of the cranks, as F and M or E and N, are pulled toward the crosshead, and thus tend to push the rod R outward. This is resisted by the bell-crank lever S, which is supported by a plate resting on a diaphragm which closes the top of the cylinder T. The cylinder T is either partly filled with mercury and partly with water, or filled with water and piped to a mercury or other form of pressure gauge placed in any convenient position. The pressure on the end of R is thus resisted by a column of mercury the height of which will be directly as the pressure and inversely as the size of the plate resting on the diaphragm. Thus by finding the indication of the gauge when a known pull or push is applied to S at the point of contact of R, the turning moment exerted by the engine can be calculated for any value of the reading on the gauge. The effect of centrifugal force on the levers attached to the pulley P must be eliminated, and this is done by counterpoise masses applied as indicated by the dotted lines inside the pulley. When the speed of the engine is known, the indications of the pressure gauge give the means of determining the horse-power being transmitted at any instant. When a record of the variation of the resistance which the engine experiences is required, the tube V is provided with a float carrying a recording pen, and a record drum is mounted and driven either by clockwork or by the engine itself. In cases like those of electric street car service very interesting and instructive records are thus obtained, showing the maximum power required and the fluctuations of power which occur in such service. The area of the record between the zero line and the line drawn by the recording pen is proportional to the whole work done in the time during which the record is made. This area can be very accurately and quickly obtained by cutting it out and comparing its weight with that of the same length of the whole breadth of the paper ribbon. A better method of mounting the dynamometer as an energy meter is to mount a light counter on the float and allow one wheel of the counter to be driven by contact with the face of a disk which is driven by the engine. The friction wheel of the counter should be on the center of the disk when no work is being transmitted. In the designs of the dynamometers built for use in the shops of the Rose Polytechnic Institute both the recording pen and the integrating apparatus have been included, but the integrator has not yet been attached to any of them. Arrangement can very easily be made in this particular form for checking the zero, as the thrust of R can be easily taken up by a collar, leaving S free and thus bringing the pen and friction wheel to zero.

When the dynamometer is used to measure the work given to any particular machine, P becomes the pulley driven by the belt, and A the pulley of the machine. The cross bar J is clamped to the pulley, and the action is the same as that just described.

II. Another form of dynamometer which has been used with good results is illustrated diagrammatically in Fig. 139. In this case let A be the driving and B the driven pulley. Two pulleys, C and D, are mounted on a frame E, and properly supported, so that they can be pulled together on the belt. The frame E is supported by means of a plate F resting on a diaphragm as shown. The whole weight of the frame, together with the weight of the deflected belt, should, however, be independently supported, so that a change of length of the belt while running does not affect the indications. The water under the diaphragm transmits any change of pressure on the plate F to the pressure gauge, which, as in the case above described, may be of any ordinary form if a record is not required. When a record is required a similar method to that described in connection with Fig. 138 may be adopted, and a mercury column gauge is actually used on the instrument under consideration. The lower belt being supposed the driver, it becomes tighter and the upper slacker as the power increases; thus greater pressure is thrown on the plate F. This, however, does not sensibly change the positions of the pulleys or the deflections of the belt, which must be stretched sufficiently to prevent the upper half of the belt becoming slack when the maximum power is being transmitted. This apparatus may be standardized statically by placing a weight on the belt above the pulley D, but when possible it is better to standardize it by causing the machine to do a known or measured amount of work. In many cases this can be readily done by means of a brake. In the case of electrical machinery a definite increase of work may be obtained and measured electrically.

A part of a diagram of work taken from a test of the Terre Haute Electrical Street Railway is given in Fig. 140. This diagram is interesting as showing the extremely rapid variation of the power which the engine was called upon to deliver, and the promptitude with which the call was responded to by the belt. Variation of speed is not taken account of here, as no separate time marker was placed on the apparatus. The time scale marked on the diagram is therefore to be taken as simply the average speed of the paper. The diagram here shown is similar to the remaining portion, which contains the record of a complete day's work, and is therefore of considerable length.

III. Perhaps the most interesting of the dynamometers here described is that the principle of the arrangement of which is illustrated in Fig. 141. In this figure, B represents the belt which is supposed to be driving the pulley A. Bearing on the belt and

just clear of the pulley two measuring wheels C and D are fixed. These measuring wheels communicate their motion to two counting wheels H and J, one of which, H, carries a dial, while the other carries a pointer K. Both the dial and the pointer are turned in the same direction, so that, if both pulleys C and D make the same number of turns, the pointer K and the dial H turn at the same rate. When the belt is called on to transmit work, however, the tight side of the belt runs faster than the slack side, on account of its smaller section. What is commonly known as the elastic creep of the belt is increased, and hence one of the pulleys makes a greater number of turns per minute than the other. Either the dial or the pointer goes ahead, and the rate of gain is proportional to the rate of working, while the total gain in any time is proportional to the total work done in that time. This dynamometer, as it has been made for laboratory use, has provision for adapting the distance between the pulleys C and D so as to fit any size of pulley A up to six feet diameter. The whole is mounted on a shaft, which, when the machine is in use, forms a continuation of the driven shaft, while $F\,C$ and $G\,D$ are carried by arms which allow the counting wheels to be placed at different angles apart on the driven pulley. The object of this is to enable the gradual increase of speed of the belt as it passes from the slack to the tight side to be illustrated. In this particular dynamometer there is a double worm and gear reduction between C and J, and between G and H, which causes 2,500 turns of the counting wheels to give one turn of the dial and pointer. One per cent. of creep thus causes the relative motion of the dial and index to be one turn for 250,000 turns of the wheels C and D. With wheels 1 foot in circumference, and a belt speed of 5,000 feet per minute, which is nearly the actual case for one of our dynamos, we get one turn of the index on the dial in 50 minutes. Full power gives considerably more than this, and therefore for continuous working the speed of indication is fast enough. For a power indicator with slow speed belts the reduction is too great, as in this case it should be possible to measure the work done in one minute accurately. For such purposes it is intended to put on a steady deflection indicator worked by the counting wheels. Suppose, for example, an axis driven by $C\,F$ and carrying a wheel turning with the shaft, but free to move sideways. Let this wheel run in contact with the face of a disk driven by $D\,G$. The wheel will move to the position on the disk where there is no slip, and it can therefore be made to turn a pointer and indicate the rate of working at any instant.

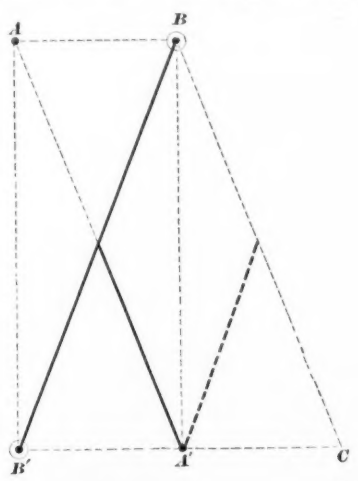
No attempt has been made to give details of construction. The object has been simply to point out the principles on which these dynamometers act; any one wishing to use similar devices will readily supply the details of construction suitable for his particular case. I have to express my obligation to my colleague, Prof. Ames, without whose assistance in preparing the diagrams I could not have found time to present these papers.

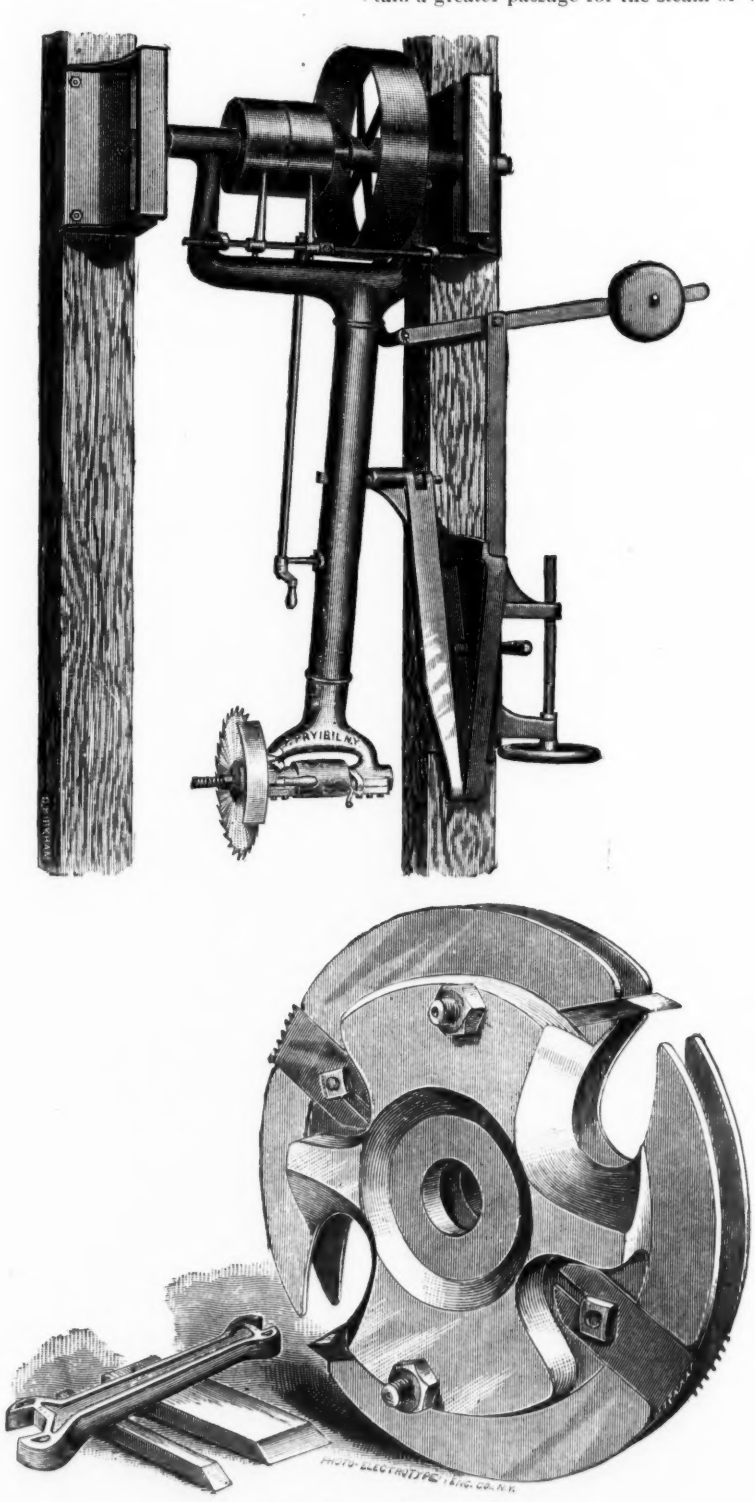
Parallel Swing Cut-off Saw.

We present with this, engravings showing the construction and operation of a new swinging cut-off saw, which is so made that the saw advances in a straight horizontal line instead of in an arc of a circle as usual, thus making it possible not only to use a considerably smaller saw than would otherwise be possible, but making the machine available for other purposes also, notably for dado work, for which purpose a suitable dado head is furnished for the machine. One advantage of this machine for dado work is that the work is always in plain view, which is not the case where the head is under the stuff worked.

The head, as illustrated, consists of two brass flanges, provided with scoring knives, which can be adjusted to compensate for wear, and with interchangeable routing cutters to correspond to the width of the grooves to be cut. This head is, of course, also adapted to use on any other machine suitable for such work.

The principle of the construction of the machine, by which the saw or head is advanced in a straight line, is shown by the accompanying diagram. Lines $A\,A'$ and $B\,B'$ form the diagonals of the rectangular parallelogram $A\,B\,A'\,B'$. So long as the diagonals bisect each other, the lines joining their extremities will form a rectangular parallelogram irrespective of the variation in the angles formed by the intersection of the diagonals. If now the point A' be fixed in its position, and the point B be constrained to move in a straight vertical line $B\,A'$, the point B' will of necessity follow the horizontal line $B'\,A'\,C$.





PARALLEL SWING CUT-OFF SAW.

In the machine the line $B\,B'$ is the main frame connecting the saw arbor B and the overhead shaft B. The lower half of the diagonal $A\,A'$ is a link swinging on a fixed pin A'. The overhead shaft is carried in boxes, which are fitted to slide vertically in guide ways, and the saw arbor is thus constrained to move in the straight horizontal line $B'\,C$.

The height at which A' is fixed is variable by means of a hand-wheel and screw, thus making the height of the saw above the table variable.

The overhead shaft should, of course, be driven from a shaft placed at the same height, so that the belt will not interfere with the vertical motion.

The maker of the machine is P. Pryibil, 498–510 West Forty-first street, New York.

Pattern Making.

BY P. S. DINGEY.

V.

DOUBLE-BEAT VALVES.

The object of double-beat valves is to obtain a greater passage for the steam or water than can be had with single-beat valves of the same diameter and lift. They are sometimes called "Cornish" double-beat valves; this may be due to the fact that they are used in all large pumping engines made in the county of Cornwall, England.

There are many types of these valves, some being designed for pumps, and others for engines. One that is suitable for pumps is shown in Fig. 24, page 6, while Figs. 25 and 26 are two views of one suited for engines. The pump valve has gun metal seats inserted at $a\ a$ and $b\ b$, but in Cornwall the "Bal Cap'ns" (mine managers) favor tin seats.

The valve and cage in Fig. 25 are usually made entirely of gun metal. Fig. 26 is a half section and a half plan of Fig. 25, and it is proposed to make these two patterns as shown in Figs 27 and 28. Some exceptions may be taken to this way of making them, preference being given to solid patterns, with core boxes for coring out the inside. This latter method would certainly give much stronger patterns, but by constructing them as shown the amount of work in the foundry would be considerably reduced by not having any cores to make or set, except those for lightening the upper part of the valve cage at $c\ c$. However, should the pattern appear not strong enough for constant use (though it probably would be under ordinary circumstances), a metal pattern might be made from the wooden one, double shrinkage and finish being allowed on the original.

By referring to Fig. 27 it will be seen that the pattern for the valve cage is parted at $d\ d$ for the convenience of molding, it being intended to mold it in a three-part flask, allowing one part of the pattern to be drawn in an opposite direction to the other, as indicated by arrows. The seats should be cast down, to insure perfect surfaces. The four side pieces which divide the four openings should be mortised firmly into the upper ring, and two dowel pins glued and driven down through into each, as represented by dotted lines. The lower ends of these four side pieces are not secured to the lower part, but doweled together for parting.

It will be well to give the upper ring plenty of draught on the inside and outside, for as it has to be turned and bored it will not affect anything by so doing; also give the four side pieces plenty of taper—it will make a wonderful difference in the molding.

Figs. 29 and 30 are two views of the core box for coring out the upper ring, and the print to receive the segmental cores from this box is shown at $f\ f$. These cores will have to be secured in place by nails. In Fig. 26 it will be seen that there are small bridges at $g\ g$, which are formed in the core box, print $f\,f$ being a continuous ring. In Fig. 27, A represents one section of the mold; at present it is the top, but it will become the bottom, as the mold must be "rolled over"—as the molders say—in order to cast the faces of seats down. After lifting off A, that part of the pattern having the ring and four side pieces attached is drawn out, and the cores set in the part of mold just lifted. It is optional on the part of the molder whether he puts on top A again before rolling over the mold, or rolls it without doing so; it is probably safer to put A on again, as it will support the center while turning over. When this is done, section B of the mold is lifted off, and the remaining part of the pattern is drawn out.

The pattern for the valve (Fig. 28) is also made to leave its own core, like the cage, and is built up with segments; it is parted at e, one part being turned to fit into the other. The upper arms are made fast, but the lower ones should not be fastened in; the reason for this will appear later on. This valve pattern is parted at e for the same reason as the cage pattern in Fig. 27 is parted at $d\ d$, that is, for convenience of molding, but the process of drawing these parts of the pattern differs from that in Fig. 27. The upper and lower part of the valve cage were drawn in opposite directions, as was explained, but the upper and lower part for the valve will be drawn in the same direction.

The valve is molded and cast in the same position as shown in Fig. 28. After the cope is taken off, as represented, the pattern as far as the joint e can be drawn out, after which the cheek E may be lifted, allowing the lower part of the pattern to be drawn also, and leaving the loose arms behind. Before these arms can be taken out, the cheek E and cope must be put back in place, and the whole mold with the bottom F rolled over. Then F is taken off in order to draw out the arms; the joint of F runs along line k to l.

These two patterns being completed, let us

start in on the pump valve in Fig. 24, which is shown opened, the passage of the water being indicated by arrows.

Figs. 31 and 32 are two views of the pattern for the stationary part *C*, and Figs. 33 and 34 for the valve *D*, which lifts up and down on the seats *a a* and *b b* in Fig. 24.

Fig. 31, like Fig. 27, is cast the opposite way to that shown; this is done in order to get the valve seats free from dirt. The ring *M* is loose, but *N* is fastened to the four wings. The center guide *P* is also made loose, so that it can come away with the drag section of the mold. Fig. 31 represents this section of the mold taken away, but *P* is left behind for the sake of explanation. The four wings and the part *N* of the pattern are now ready to be drawn out of the sand, and this being done, the round end core that cores out the center guide *R* (Fig. 24) should be set and tied down in the drag or lower section of the mold, and as there is no other place for the vent to be taken off, it will have to come off through the bottom, the bolt hole being drilled.

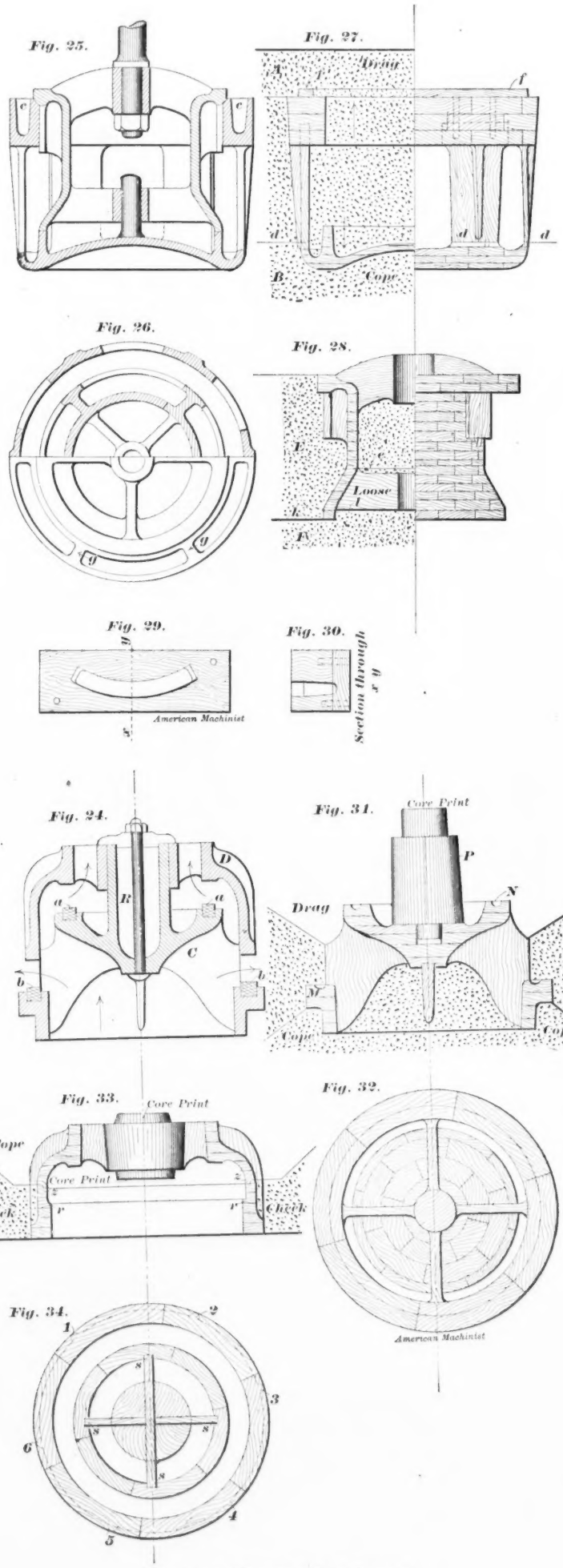
The reason for setting this core now is to save lifting off the middle after it has been rolled over onto the drag with the cope, for it is clear that if this round end core was not set before the middle was set onto the drag, that the core could not then be located.

The reader must now imagine the whole mold to be turned over in the position in which it will be cast, and with the cope taken off; he will then see that it is only required to draw the loose ring *M* out, and close the cope to complete the mold.

As to the valve *D*, a glance at the two views of the pattern in Figs. 33 and 34 will show that there is much less work about this pattern and the molding than the one just described. Like the other style valve, it is cast in the same position as shown in Fig. 33, and the pattern is made in two parts, coming apart at *z z*. The four arms seen in Fig. 34 are half-checked together at the center, and four corner pieces glued in, to form the hub. These arms are let into the ring at *s s*, *s s*, Fig. 34. The projection on the inside, seen in Fig. 33 at *r r*, is made, so that when the casting is bored out at that place there will be a clearance for the wings in much the same way as in the counterbore of a cylinder where the piston runs over.

There are six ribs on the outside, which are numbered in Fig. 34. They are intended to prevent the valve from springing. The molding of this pattern is similar to that in Fig. 28.

In many cases the best way to explain how a pattern should be made is to describe the manner of parting the mold. This is the plan that the writer has partly pursued in this article, the purpose being to make it clearer as to the way of constructing the patterns than otherwise could be done, though to very many readers of the AMERICAN MACHINIST a glance at the illustrations will be all that is needed in order to understand the way in which the patterns are made.



PATTERN MAKING.—SEE PAGE 5.

Literary Notes.

A MANUAL OF THE STEAM ENGINE. Part II. Design, Construction and Operation. For Engineers and Technical Schools (Advanced Courses.) By Robert H. Thurston, A. M., LL. D., Dr. Eng'g.; Director of Sibley College, Cornell University; Formerly of U. S. N. Engineer Corps; Past President Am. Soc. Mech. Engrs.; Author of "A History of the Steam Engine," "Manual of Steam Boilers," "Materials of Engineering," etc., etc.

This second part of the Manual of the Steam Engine is, in some sense, an independent work. The first part, which has been noticed in a previous issue, may be considered as a brief summary of the purely scientific side of the subject; the second part is intended to present the later and more usually practiced methods of design, construction and operation of the engine, as based upon the technical knowledge and the professional experience of contemporary specialists. The various chapters treat on the design of the steam engine; valves and valve motion; regulation, governors; fly-wheels; inertia effects; construction and erection; operation, care and management; engine and boiler trials; specifications and contracts; finance, costs and estimates. In the preparation of this work the author's aim has been to provide suitable instruction for graduate students in mechanical engineering—men who have completed the somewhat extended and purely professional course of late years taught in Sibley College, at Cornell University, and who have, either with or without a period of intermediate professional practice, entered upon a post-graduate course of higher character and more extensive range; for this purpose the book is well adapted, and its usefulness in the class room will undoubtedly be appreciated; but for office use, or in the hands of practical men, it may prove to be disappointing. The price of the book is $7.50. It is published by John Wiley & Sons, 53 East Tenth street, New York.

MANUAL OF SCREW CUTTING. By William Simpson. Fifth edition. Revised.

This is a small book containing plain rules and directions for cutting all kinds of screws on all kinds of lathes, illustrations being used wherever needed to add clearness to the matter treated, and tables being given for convenient reference. The book is written by a machinist for machinists' use, and should prove useful to them. There are forty pages, 5¼"x3½", flexible cloth binding. Published by S. Woodberry & Co., Boston. Price, 30 cents.

We have received a copy of the Report of the "Special Committee on Prevention of Smoke" in St. Louis. This committee consists of Messrs. E. D. Meier, William B. Potter, Robert E. McMath, and C. E. Jones. It goes into the subject of smoke prevention quite thoroughly, and will no doubt prove of great value, not only in St. Louis, but in other places as well where the matter of smoke prevention is of importance. The pamphlet reviews what has been done in that way in other cities, and makes recommendations of a practical nature for the guidance of steam plant owners and engineers, and for city authorities who may have the matter to deal with.

THE METAL WORKER ESSAYS ON HOUSE HEATING.

This is the second edition, revised and enlarged, of a series of essays which were originally published in *The Metal Worker*, and met with a favorable reception owing to the comprehensive way in which they covered the subject of house heating by the various systems in use. The present volume contains all that was in the first edition, together with selections from the letters of criticism called out by the publication of the essays in serial form. To the collection there is also added a chapter entitled, "Proportioning Radiating Surfaces," written by Mr. John J. Hogan. The book is practical, and will prove very useful to all who have to do with arrangements for heating and ventilating houses. It is published by David Williams, New York. Price, $3.

LETTERS FROM PRACTICAL MEN.

The Trolley Wire.

Editor American Machinist:

Your correspondent—Cecil P. Poole, Electrical Engineer—in your issue of June 16, shows himself such an adept at blackguardism that he will, so far as I am concerned, have the field to himself. He asks me to substantiate statements I did not make, and hangs me up without an alternative as sure to "disclose a lamentable ignorance or willful desire to misrepresent."

Mr. Cecil P. Poole, Electrical Engineer, cannot, perhaps, see that anything is "dangerous" except that it is sure death, and probably would rather relish shocks that kill "horses or other inferior animals," which shocks do not, to him, appear "dangerous."

I have nothing further to say except to advise Mr. Poole to watch the accounts in and from the daily press, with a view to learning things he does not appear to know, notwithstanding his "position to get at facts." In addition, it might be recommended to him that the ability to call names is generally considered a vulgar acquirement, the practice of which is usually resorted to only when argument fails. I am truly sorry that things appear "disgusting" to him. J. H.

Self-oiling Bearings.

Editor American Machinist:

I noticed a statement in a recent number of a trade journal that it was not safe to depend on a self-oiling box, but to oil from a can every day. This is looking backward to my old apprenticeship days, when it was my pleasant duty to oil up line and countershafts. While never laying any claim to being an extra good cub, still, my aim always was to do exactly as instructed, but I well remember several difficult oil holes that could only be reached by the most artful handling of the can, and then only at the expense of a large waste of oil, some following the laws of gravitation and dripping, or, more properly speaking, pouring down on Jim on the big lathe, lubricating his jaw to the extent that probably his counter would be skipped on the following morning rounds.

Now the adoption of self-oiling bearings, especially on overhead work, means less liability to accident to attendants, less trouble to the foreman watching the oiler and the oiled, better lubrication in every sense of the word, economy both at oil tank and coal pile, and last, but not least, cleanliness. There is a certain feeling of safety that things are going to run cool all day with their use, that the old ¼-inch oil hole bushed down to $\frac{1}{16}$ or even less, with the accumulation of cheap oil and dust, could never furnish.

I say cheap oil, for it is generally the case that where a material so wasted as oil is, the

tendency in the office is to furnish cheap grades.

There are several points as to the kind of oil to be used on different kinds of bearing material. Never use lard oil in self-oiling babbitt bearings; they don't affiliate, although they will sometimes "speak as they pass by"; use sperm oil made from a fish, and not cotton seed, and thin it with coal oil, using about 1½ pints to one gallon of oil; this keeps the oil channels clean, and insures a free distribution of the oil. Use lard oil on bronze or cast-iron, but the addition of coal oil—one quart to one gallon—helps to keep things contented.

Avoid the use of wicks, as they are treacherous; better use chains or rings for distribution.

To return to the "oil-every-day" way, I would say that we have a 2 15/16" shaft, about 300 feet long, running in self oiling bearings, 7½ feet centers, that has run for nearly eighteen months without the addition of an ounce of oil in a single bearing, and we are going to run it another eighteen months if present indications are to be trusted. While the oil is a little thicker in the cellars than when first put in, it flows readily to all parts of the bearings, which are always cool. That shaft is cold-rolled iron; bearings ring oiling, four diameters long, and the oil sperm and kerosene.

Feeling perhaps that the solidified oil man might be antagonistic should nothing be said about his "dope," would say that a very neat way for supplying bearings with the same came to my notice the past week. I think the device is patented, however. A cylinder about 8" diameter by 30" long is fitted with a piston; the upper end of the piston rod carries a pivoted arm, which can be weighted as desired. A pipe or pipes leading from bottom of cylinder throughout the shop, terminating at the different bearings and supplied at each bearing with a cock to regulate the amount of feed. Fill the cylinder with the grease, add enough weight to arm to force the grease to the furthest bearing, and regulate with the cocks alluded to. There are no springs or valves to get out of order, and, as the loquacious dopeman can now furnish (and is perfectly willing to) a material that will not melt in a cupola or that will not congeal encased in ice, it should flow nicely in any temperature. The device spoken of has been in use through the past winter, and has caused no trouble.

"GRANGER."

Just about this time of year the daily papers are occupied with descriptions of places where the tired worker can sojourn a couple of weeks at a cost of two or three hundred dollars. Probably a little more attention to the matter of showing where the mechanic who works for fifteen or eighteen dollars a week could afford to spend two weeks of the summer would interest a far larger proportion of the readers of these papers. We commend this to their attention.

Master Mechanic Convention Notes.

During the convention the Schenectady Locomotive Works had three compound locomotives side-tracked, which were seen generally by the members. One of these was a ten-wheeler, cylinders 20" and 30"x26", drivers 5 feet 10" diameter, weight on drivers 108,000 pounds; total weight 141,000 pounds.

Another was a twelve-wheeler with cylinders 20" and 29"x26", drivers 4 feet 3", weight on drivers 116,800 pounds; total weight 138,000 pounds; and the other a mogul with cylinders 20" and 30"x26", drivers 4 feet 11", weight on drivers 114,500 pounds; total weight 132,500 pounds.

The supply men were in full force, as usual, almost everything being on exhibition that is used in the mechanics of railroading.

An excursion was made to the Schenectady Locomotive Works, which was much enjoyed by the visitors.

In the tests for water used, made by the committee of master mechanics, in getting at a comparison of the efficiency of compound and simple locomotives, two "Thompson" water meters were used, one on each side, in the suction pipe.

A U gauge in the cab was connected with the front end by a ⅜' pipe, and by this means the vacuum was measured.

An Edson recording gauge was employed for measuring the steam pressure. Just why this should be called a "novel method" is not apparent.

The pop valves were found to waste about 168 pounds of steam per minute when blowing; this shows their efficiency to reduce pressure in a very satisfactory manner.

The means of measuring the quality of steam were not very satisfactory for this purpose; there is nothing very satisfactory for this purpose; there is ample room for the invention of something better.

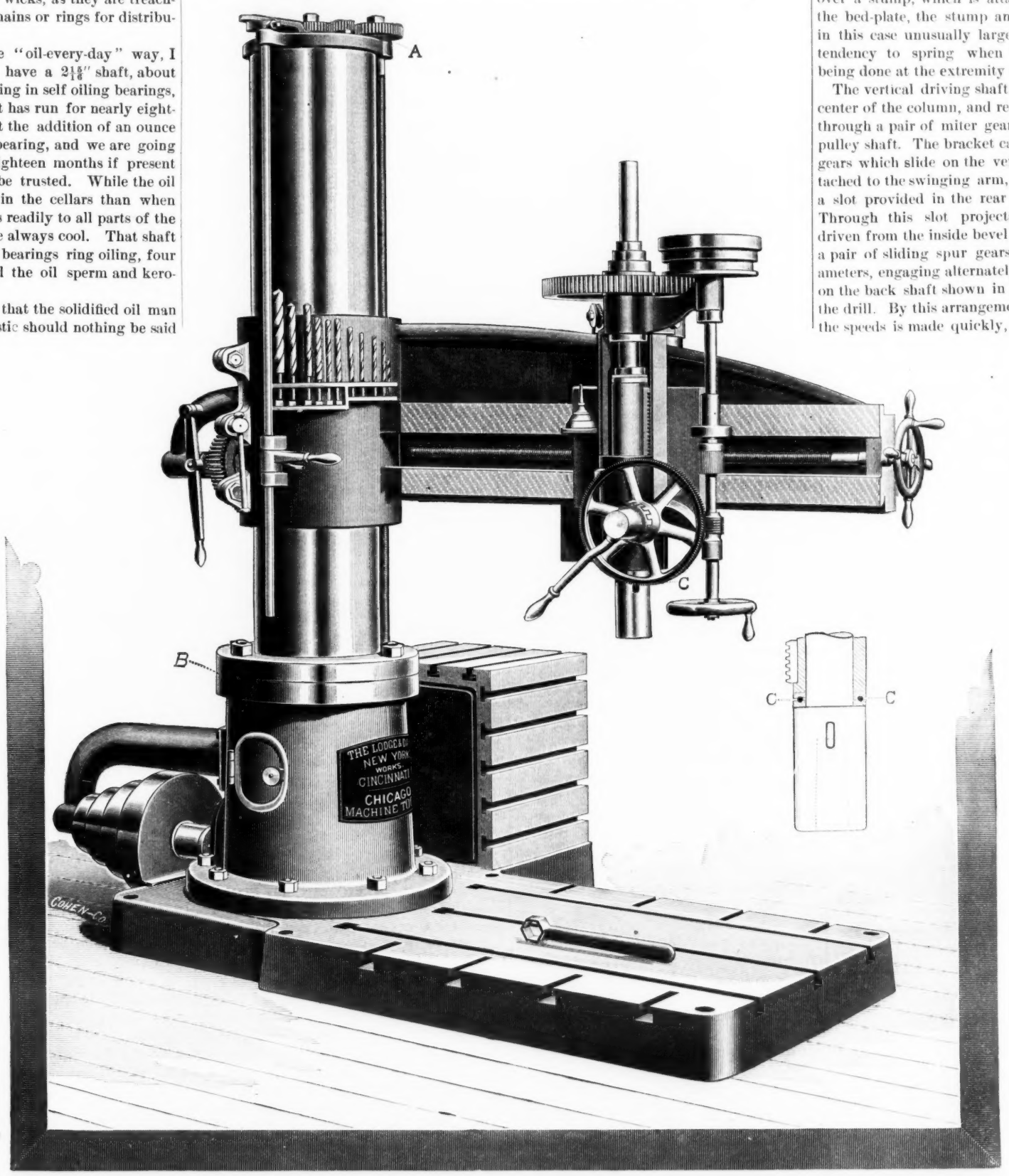
Thomas J. Bowditch died recently at Troy, N. Y., at the age of 71. Mr. Bowditch was a blacksmith by trade, and one of the best that ever worked at it. He was for some years foreman blacksmith for the (then) Troy & Boston Railroad, and for a long time foreman for Starbuck Brothers, of Troy. He held, for eight years, the position of foreman of the State repair shops at Cohoes, N. Y. He was a regular writer for the *Troy Times*, his writings demonstrating a wonderful amount of reading and research. Personally he was companionable in every respect, kind hearted and charitable, and will be missed by a large circle of friends.

The rain-making experiments have not proved the success of the plan; nature appears to object.

Radial Drill Press.

The accompanying engraving is of a radial drill press which has been recently brought out by the Lodge & Davis Machine Tool Co., Cincinnati, O. It belongs to that class of such machines in which the column is fitted over a stump, which is attached rigidly to the bed-plate, the stump and column being in this case unusually large, to obviate the tendency to spring when heavy work is being done at the extremity of the arm.

The vertical driving shaft is placed in the center of the column, and receives its motion through a pair of miter gears from the cone pulley shaft. The bracket carrying the bevel gears which slide on the vertical shaft is attached to the swinging arm, and traverses in a slot provided in the rear of the column. Through this slot projects a short shaft driven from the inside bevel wheels carrying a pair of sliding spur gears of different diameters, engaging alternately with the gears on the back shaft shown in the rear view of the drill. By this arrangement the change of the speeds is made quickly, and at the same time the driving gearing is close to the spindle. The entire internal driving mechanism is accessible from the outside, and can be taken apart without taking down the drill.



RADIAL DRILL PRESS.

The thrust bearing of the drill spindle, the column and the elevating screw denoted by letters *A*, *B* and *C*, are provided with the Ross patent anti-friction ball bearing, which diminishes the friction to a great extent, and avoids the oiling and cutting in these bearings. The swinging arm is very rigid, and is raised and lowered by power.

The drill head has an extra large bearing on the swinging arm, and is furnished with the builders' quick-return motion, well known from their line of upright drills. These drills are furnished with double friction countershafts arranged for tapping, and are made with 5 and 6-foot arms.

The fifteen-inch aerial torpedo thrower, now being introduced as a British service weapon for coast defense, resembles in appearance a powder gun, having the axis of its trunnions at or near the center of gravity of the barrel.

The coal combine—or the "Reading Deal"—has decided upon another rise in the price of anthracite. We only mention this as being quite in accord with the nature of things.

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NEW YORK, JULY 7, 1892.

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The Master Mechanics at Saratoga.

We gave, last week, the brief reports permitted by our space of the proceedings of the Master Mechanics assembled at Saratoga. To have given the proceedings in full would have required all the space in two or three issues of the AMERICAN MACHINIST. Still our report gave such a synopsis of the leading features of the convention as to enable fair conclusions to be arrived at.

The Master Mechanics Association has been in existence about twenty-five years, and it is, to day, one of the very foremost associations in the world founded on a knowledge of mechanical matters. Its membership is made up of men who have learned their lessons in the exacting school of practice, to which all theory and all science must pay tribute. When such men meet together in convention, the practical side of every question brought up is the prominent side. This is not saying that they are not educated—the majority of them self-educated—in the theory and the probable science of matters that come before them, but all this gives way to practice. The great mechanical interests of railroad operation—the questions involved—only become scientific facts through the testimony of every-day practice. Their experience has taught them to use theory for what it is worth, and for no more. Not to despise it, but, truth to tell, to distrust it.

The master mechanics of to-day are not the master mechanics of twenty-five years ago, who were men possessing an amount of executive ability sufficient to enable them to exercise good judgment in hiring and discharging men, and such a general knowledge of mechanics as would enable them to meet the ordinary emergencies that were likely to beset them. And it required no mean ability to do this with the resources at hand.

The old-time master mechanics have surely gone, and in their places have appeared men who deal with greater problems in the light of greater knowledge—men who use theory and science in a guarded way, and when approved by practice. The master mechanic of to-day, like his prototype of a few years ago, is a man who puts practice to the fore, but he tempers his own practice with a knowledge of the practice of others. His science is reconstructed every day, if it appears at all necessary to reconstruct it. The master mechanic of to-day is a man intrusted with great practical responsibility in the mechanical matters of railroad operating, and he realizes that it is better to go slow than go wrong. It is, therefore, not strange that at the Saratoga meeting the practical side of every question presented was the side that received the most consideration, or better, perhaps, the practical side of every question was the one that was turned to the light.

This was particularly noticeable in the discussion of compound locomotives.

It is but a short time since compounding has received attention from railroad men. The utility of the compound condensing engine had been strongly disputed, and the war against non-condensing compounds had been more fierce This was about the status of the case when compounding was introduced on some of the railroads of Europe; it had been settled that compound condensing engines were valuable in an economical sense, but the advocates of simple cylinder engines had by no means, and have not yet, given up their contention that there could be no economy in a compound non-condensing engine. It is the trial of these very same non condensing engines on railroads that brought out, at Saratoga, what was probably the most interesting discussion that was ever had by a body of mechanics in this country. This discussion developed this fact, at least, that master mechanics had become masters in debate; that they did not require any one to supply them with words, or tell them how to put them together.

A committee of master mechanics had been appointed to report upon compound locomotives from tests actually made, and this committee presented a report involving an immense amount of labor. It was the consideration of this report that afforded an opening for the able debaters of the association. The committee did not put an exaggerated estimate on its work, and evidently expected it to be criticised by those who had superintended the operation of compound locomotives on the roads under their charge mechanically.

It may seem at first thought, even to mechanical engineers, that the settling of the question of the economy as between a simple and a compound locomotive would be an easy matter. If the determination of this was between two stationary steam engines used for ordinary purposes the matter would be comparatively simple; but the difficulties of determining the comparative efficiency of two simple locomotives is nearly insurmountable. In point of fact, the actual economical performance of a locomotive working under any conditions has not yet been determined to that degree of exactness that give to the conclusions any of the value of scientific exactness. When it comes to comparing the efficiency of two engines, one a compound, the difficulty can hardly be over-estimated.

Some of these difficulties may be briefly stated: The run must be made under the ordinary requirements of every-day work. Considering this, it will be seen that the coal must be used as it is used in common practice, and this means an "estimate" at stopping and starting that may be wrong to the extent of a large percentage, considering the capacity of a locomotive fire box. This is one way in which the "estimates" may be widely astray. Then the power must be measured if that plan is adopted, and with the speed of a run varying from nothing to the maximum this is no easy matter; in fact, it is a very difficult matter.

It is for comparatively short intervals of time that these calculations must be made, and the probable errors—one of which cannot be calculated upon to counterbalance, in any degree, the other—lead to a distrust of such a method. But even if this was admitted as satisfactory, it would cover only one set of conditions that might be varied on every run. This has led to the very unsatisfactory expression of "train mile," and the like.

It might seem that the proper way to measure the efficiency of a locomotive was by the water used per horse-power developed. This is fairly susceptible of measurement, but with the present practice of "picking up" water an element of difficulty is introduced. But assuming that the water used could be accurately measured, this does not cover the question as between simple and compound locomotives, not even if the power developed be accurately measured. For the advocates of compounding claim that the more desirable effect of the exhaust is responsible for a good deal, or all, of the advantages of the compound over the simple locomotive; that is, that the easier exhaust of the compound makes the boiler in effect a larger one, in that steam is generated with less waste of fuel. There is reason in this, because it is well known that, measured by ordinary practice, the locomotive boiler is overworked, and that by the sharp *lifting* character of the exhaust from the cylinders of the simple engine the fire is destructively disturbed.

There are, it must be admitted, two divergent opinions, one being that by the saving of steam in the cylinders the boiler is made, comparatively, larger, and hence is worked with better economy. Another is that there is no appreciable saving in steam in the cylinders, but that the way it is used brings about economy in its production.

The foregoing are only a few statements of the difficulties in the way of a comparative test of compound and simple locomotives. To these might be added the opinions that compound engines should be made for special rather than for general purposes, and the consequent reason for compromising for the variations incident to railroad traffic, and, *per contra*, that no such allowance should be made; also that there are differences in the boilers of the two types of engines, and various other differences. Altogether it is no wonder that the committee failed to arrive at a definite conclusion, and that the spicy discussion was evolved. It was in every way good for the interests of railroads, and engineers generally will find the full discussion of compounding by the master mechanics interesting reading.

The recent accident on the Pennsylvania road near Harrisburg, by which twelve people were killed, will be rather a rude awakening to those people who have supposed that this road, about which so much has been said since the accident on the New York Central, was entirely safe from rear end collisions.

It is shown that, after all, the correct working of railroads must ultimately depend upon the fidelity, the intelligence and the vigilance of men, and that, even with the best of devices, there is always some one in whose power it is to sacrifice the lives of passengers.

An engineer pulling the second section of an express train upon a road upon which block signals are used will naturally run all the more confidently and rapidly on that account, for, seeing the signals set clear ahead of him, he will consider that he has the right to assume that the track as far as the end of the next block is clear, and that he can run over it as fast as the schedule will permit. For this reason there is all the more necessity either for a perfect automatic system, or, in the absence of this, the most strenuous vigilance on the part of those in charge of the towers. It seems that the man who made the mistake of letting the train into a section before receiving notification of its being cleared by the preceding train was young and rather inexperienced, but it also appears that the same mistake had been made before. There are devices which absolutely prevent this thing being done, the signal being absolutely blocked until the operator at the next tower unlocks it.

Another thing which is prominently brought out by this accident is that rear brakemen sent out to protect the rear of their standing trains should not consider the call of the engineer to come to the train to be an imperative one, but merely as an announcement that he is ready to go ahead, and that the brakeman can therefore come in as soon as the conditions of safety to the trains will admit of his doing so, and, where a following train or section is due in one minute or less, as seemed to be the case in this instance, he should, of course, maintain his place in the track, regardless of whistle calls, until the following train has come up and been stopped. Experienced railroad men know all about these things, of course, but experience shows that they will neglect well-known precautions and assume risks especially forbidden. It is done every day and on nearly every train, the wonder being that we do not have more accidents instead of fewer.

One of the anomalies of our present civilization is the apparent unconcern with which a community will arrange to turn its sewage, containing the most filthy, repulsive and unwholesome substances, directly into its water supply, which water they then proceed to pump up and drink and use for culinary purposes.

Just now Chicago is the most notable example of this, its water being, it is said, dangerously contaminated by sewers and the river which empty into the lake so near the entrance to the water works tunnel as to make the water simply diluted sewage. The instincts of savages would teach them better than to do such a thing. They would naturally avoid such polluted water, and would not wait for a chemical analysis to tell them whether it were fit to drink or not.

Mr. John A. Hill, of *Locomotive Engineering*, sailed on Saturday, the 25th ult., on the "Ems," for Europe, where he goes especially to study railroading as practiced in Great Britain and on the continent. On the night previous to his sailing a company of his friends, among them a number of prominent railroad people who had been attending the M. M.

A meeting in Saratoga, met at Duke's Hotel, near the dock, and spent a few hours in seeing to it that he and Mrs. Hill, who accompanied him, got a fair start on their voyage. There is no doubt, of course, but that Mr. Hill will see much that is interesting over there, and that his account of what he sees and hears will be interesting to his readers and friends.

One of the interesting things seen in San Francisco by the engineers who recently visited that city was the drawing through the streets of an immense wire cable, arrangements having been made so that the visiting engineers might conveniently witness the proceeding. An official bulletin issued to them gave the following facts regarding it:

"Cable manufactured by the California Wire Works, San Francisco, for the Ellis street line; length of cable, 28,020 feet; size of cable, 1¼ inches diameter; time making, 52 hours; net weight of cable, 72,830 pounds; net weight of reel, 6,090 pounds; net weight of truck, 30,000 pounds; gross weight hauled, 108,830 pounds; number of horses in team, 60; number of men driving, 15."

The truck had not proceeded far, however, after passing the assembled engineers, before an accident occurred, which seemed likely to cause some difficulty. A bolt which held the right forward wheel in place came out, and before it was noticed the wheel came off, letting the axle drop to the ground, and breaking it. Owing to the great weight of the load it was thought best not to unload the cable, but to jack up the truck and repair the damages where it stood, which a force of mechanics immediately proceeded to do.

Plans are being examined for the construction of a railroad across the main chain of the Caucasus Mountains. The line will have a length of 100 miles. There are to be two tunnels, one 4⅛ and the other 6¾ miles long.

Questions and Answers.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(275) Machinist, ——, asks: Who makes machines for cutting veneering for berry boxes? *A.*—By writing to those who advertise woodworking machinery in our advertising columns, you will find that they make such machines, or can tell you who does.

(276) F. T. C., East Orange, N. J., writes: Kindly inform me through your paper how to oxidize small pieces of brass. *A.*—Prepare a solution of the following proportions: 2 ounces nitrate of iron and 2 ounces hyposulphite of soda to 1 pint of water. Immerse the articles until the desired shade of oxidation is acquired, then wash, dry and brush.

(277) J. J. M., Harvey, Ill., writes: Kindly inform me through your columns if there is a balanced slide valve patented similar to those used on a locomotive; if so, how is it balanced, and who is the patentee? *A.*—There are a few slide valves which are patented, but we cannot give a complete list of them. If this information is of great importance to you, the best way will be to engage a patent attorney to search the record of the patent office, and obtain such specifications as you may desire.

(278) H. R. C., Ware, Mass., writes: Please give me facts in the following case: If with a given cylinder head the screws are tightened sufficiently to balance a stress of 100 pounds per square inch, and then steam being admitted, will the screws suffer greater stress, or will the steam pressure have to be 100 pounds per square inch before the stress on the bolts is increased? *A.*—See answer to Question 570, in our issue of December 31, 1891.

(279) W. P. C., San Francisco, Cal., writes: Kindly answer the following question to settle an argument which arose in the shop and has been left for you to decide. A locomotive with common slide valve and link motion, having $\frac{1}{16}$ inch steam lead—will this lead be changed in hooking up the links? *A.*—The lead will increase in hooking up the link. In some engines it will increase to ¼ or ⅜ inch when the link is in mid gear. The reason for this you will find in our issue of November 20, 1886.

(280) W. A., L. I. City, N. Y., writes: You will confer a great favor by letting me know if a vessel can be propelled by a fan or, in other words, by a propeller working in the air. A friend of mine is spending his brains, and money which he can ill afford. I was told to apply to you for an honest opinion on the subject. *A.*—It can be done, but unless your friend is a mathematician, and has had considerable experience in that class of work, the probability is that he is wasting his time and money, and, even if he succeeds, it is still a question whether the device will be of any practical value.

(281) F. A. M., Orange, Mass., writes: If I have 100 pounds steam pressure and 250 pounds water pressure, what will be the pressure in the hose at 100 feet, 500 feet and 1,000 feet from the fire engine? A 1¼-inch pipe is attached to the end of the hose. *A.*—The pressure in the hose will depend on its position; that is to say, whether it lies horizontally or not, sharp bends will also affect the pressure; even if the hose lies horizontally with very easy bends, or straight, we must know the total length of the hose and its diameter (which you have not given) before we can make the computation.

(282) J. V. Y., Boston, Mass., writes: Kindly inform me through your columns what speed can be expected from a steam launch 20 feet long, 6 feet beam, with an engine 2½ inches bore, 3 inches stroke, 100 pounds working pressure, boat of good model. Also what diameter and pitch of wheel should be used? *A.*—The speed will depend on the form of lines, displacement, and on the steaming capacity of the boiler, of which we know nothing, and therefore our estimate must be considered a rough approximation. A speed of 8 miles per hour will probably be all that you can obtain. Propeller 14 inches diameter, 24 inches pitch.

(283) J. M., Salt Lake City, Utah, asks: What is the pilot of a locomotive, and for what purpose is it used? *A.*—It seems to us you have not traveled much. The pilot, on ordinary locomotives, is bolted to the front of the engine; it is made either of iron or wood, and consists of a triangular frame supported horizontally about 4 inches above the tops of the rails, and placed so that two of the sides of this frame reach from the sides of the engine to the center at the front; straight bars are fastened to these sides, and extend to a horizontal piece bolted to the bumper. Its purpose is, as its common name, "cow-catcher," indicates, to remove any obstacles, such as cattle, fallen rocks, etc., which may be in front of the engine.

(284) H. P., Bruxelles, France, writes: Kindly let me know how engineers in America calculate the weight of fly wheels for steam engines. *A.*—Many engineers use the formulas given by Dr. J. Weisbach, or Professor Rankine, or a modification of these formulas to suit the nature of the work to be done by the engine. The following formula is frequently used by builders, and is considered to give a weight of rim for a simple engine to suit about the maximum requirements for any duty except, perhaps, for rolling-mills and similar extreme cases.

$$\frac{12{,}000{,}000 \times A \times S}{D^2 \times R^2} = W;$$

in which A denotes the area of the piston in square inches, S the stroke in feet, D the diameter of the fly-wheel in feet, R the revolutions per minute, and W the weight in pounds of the rim of wheel. But cases will be found in which wheels of but little more than two-thirds of the weight computed by this rule will be sufficient, and consequently much is left to the judgment of the designers.

(285) J. E. B., Holyoke, Mass., writes: Kindly give me through your columns your opinion in regard to cutting oil ways in shaft boxes. To what depth should they be cut, and the reasons for deep cuts, if any? Is any particular direction of the cut preferable? Can you refer me to any literature on the subject? The shaft in question is an engine shaft, running in a box as indicated in the sketch, Fig. 1. *A.*—There are several modes of cutting oil ways in journals; we believe a good way is to chamfer the edge *a* of the bearing, and then cut the oil ways crossing each other as shown in Fig. 2; in the cap they should be cut as shown in Fig. 3, commencing from the oil hole, and crossing each other. Sometimes they are cut as shown in Fig. 4, but these oil ways do not lead the oil to the center of the journal, and there is a liability of the journal heating at the center. In regard to depth no rule can be given; about $\frac{3}{16}$ inch deep and $\frac{3}{16}$ inch wide for journals 5 inches diameter and upwards will give satisfactory results. In all cases they should be deep enough so as not to clog up, and be effective even after the journal has worn a little. We have not seen any literature on the subject.

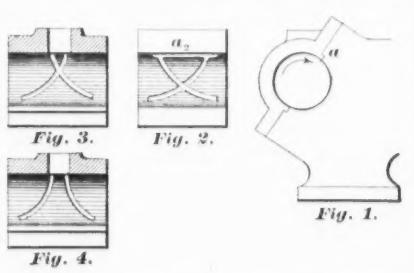


Fig. 3. Fig. 2. Fig. 1.

Fig. 4.

(286) R. K., Columbia, S. C., writes: In order that you may better understand the questions, I give you the following facts. I was called to a cotton factory to examine the piston rod of a 300 horse-power engine, on which the engineer had found a crack. With the aid of a strong glass I found two cracks, one running around the rod in an irregular way; the other, about 2 inches from the first one, running nearly half way around. I could feel the cracks with my finger nail when the rod was hot, but not so plainly when cold. I put oil on them, and let it stay all night, then used a hammer to jar the crack, but no oil had gone in, as they seemed to be filled with metal from the metallic packing. I advised to put in a new rod, and keep a close watch on the old one until the necessary repairs could be made. Now what I would like to know: Is there any means of testing the depth of a circular crack in a piston rod in service? *A.*—We do not know of any method of testing the depth of the crack. Our opinion is that in your case the piston rod was made of iron, and twisted during forging, and the so-called cracks were simply flaws in the surface of the iron. However, you did right to order a new rod, and not run any risk of a general smash-up. 2. Will putting cold water on a hot piston rod 3¼ inches diameter cause it to crack while in service? *A.*—The tendency will be in that direction.

Business Specials

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Grant Gear Wheels, Gear Cutting, page 20.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Forming Lathes, Mer. Mach. Tool Co., Meriden, Ct.

Ideal Drawing Stands. M. C. Hammett, Troy, N.Y.

A. D. Pentz, Consulting. Tools. Elizabeth, N. J.

Tool Holder: Armstrong Bros. Tool Co., Chicago.

"Bradley's Power Hammers, the best in th world." 20 sizes. Bradley & Co., Syracuse, N. Y.

The Improved Justice Hammer. Williams, White & Co., Moline, Ill., manufacturers.

Pattern and Brand Letters. A variety of sizes and styles Heber Wells, 8 Spruce St., New York.

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty St., N. Y.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N.Y.

S. A. Smith, 23 S. Canal St., Chicago, Ill., is agent for Holbrook's new loaded rawhide mallets.

Automatic Gear Cutters. Best in the market. Superior Machine Works, 105 Canal St., Cleve'd, O.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker St., Philadelphia, Pa.

Most sensitive and durable Damper Regulator made; works within one pound. Send for circular. T. Kieley, 11 W. Thirteenth Street, New York.

For the Latest Improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., cor. Canal and Washington Sts., Chicago, Ill.

Patterson, Gottfried & Hunter, Limited, 146-150 Centre st., New York, are putting on the market a new alarm speed indicator. Send for circulars.

25" 32" 37" 42" "Only Drill Press built on 'Ko-rekt' principles, Even if they come from Jersey." Gould & Eberhardt, New Ark, N. J.

Just Pub.—Safety Valves, History, Invention & Calculation. By W. B. LeVan. Fully ill. $2. Cat. of Machinists', Electricians' & Engineers' books sent free. N. W. Henley & Co., 150 Nassau St., N. Y.

S. W. Card & Co., Mansfield, Mass., are putting on the market a new line of stocks and dies, with their patent adjustable dies and guide S. A. Smith, 23 S. Canal Street, Chicago, Ill., Western Agent.

Patent Soliciting of High Class.
D. Walter Brown, Counsel in Patent Cases,
31 Nassau Street, New York.
Send for Brief History of Patent Legislation.

De Lamater Screw Propeller Wheel, made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUBLISHING CO., 208 Broadway, New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 postpaid. Published by John Wiley & Sons, 53 East Tenth Street, New York.

The Position of Stop Valves—Compressed Air.

BY W. H. BOOTH.

Whether a valve should open upwards or downwards will often depend upon its surroundings.

The valve upon a steam boiler should be capable of being closed against the pressure in its particular boiler, but it should not be capable of being opened other than by the pressure of the steam in its own boiler. The foregoing, however, is a statement which carries far more weight when it refers to a stop or junction valve upon one of a battery of boilers than where a solitary boiler alone is referred to.

Unless the valve is loose upon its spindle, so that it cannot be opened except by the steam itself, there is always the danger of it being opened when the boiler has been freshly filled with perhaps cold water, and the result might be a sudden diminution of the steam pressure in connected boilers, or, worse than this, the boiler might be empty and there might be some one inside scaling or inspecting, and the accidental opening of the valve might be fatal. Equally risky is the placing of the valve below the seating, so that it opens downward against the pressure of its own boiler, and resists the pressure upon it from the main steam pipe by virtue of its connection to its spindle. In such a case a man's life may hang upon the strength of the spindle, a far more hazardous risk than the chance of a self-closing valve breaking across or the seating being forced through.

In the case of a single boiler there are no risks of scalding when the boiler is being cleaned, for there is no other steam, and arrangements for packing under steam carry more weight, but no one who has required to be inside a boiler of a battery when any one has been outside (boys playing about, for example), will deny the argument I have put forward. Of course there should be no unauthorized person about a boiler, but we all know that there are very frequently, and that in cold weather there is a tendency for the tops of the boilers to be used frequently during dinner hour, to say nothing of the multifarious culinary uses of a flat manhole cover.

If a valve is used as a blow out it should open against the boiler pressure so as to be self closing.

In case of an engine stop valve something must be also allowed to environment. In a large factory it is very usual to arrange the valve so as to open against pressure. This allows of a knock off gear coming into action when the engine races, or in case of the necessity of it being stopped from a distant room by electric or vacuum action. There can be no very serious harm done if such a valve should close accidentally.

In an electric station the case may be different, for the stoppage of an engine may plunge a district into darkness, and there are no workers in distant rooms who may require to hav the power of quickly stopping the engine.

Original design of a steam plant may take every precaution against accident, but when, as is sometimes the case, second-hand things are bought and used, there are dangers creep in. Fancy a battery of boilers, for example, in which there was a diversity of practice in regard to stop valves.

For many purposes the straightway valve is the best, but I think on a boiler there should be a valve self-closing under external pressure.

"Observer" makes some remarks upon compressed air as a motive power. I believe it is quite well understood by most engineers that for short distances, over which it is possible to carry steam in well-protected pipes, this fluid is superior to air, which loses so much in compression and expansion, but there will be soon reached a limit of distance beyond which the air will cease to lose more than the steam.

Indeed, in a bare pipe the air may in one direction actually gain by distance—barring

the loss due to the pipe friction—and there is a limit to the loss of efficiency of air, because air is a non condensable gas, whereas steam may be annihilated as steam altogether. Then again for rock drills it would be extremely inconvenient in a mine, already hot enough, to have damp hot vapor exhausted at the working face, whilst the exhaustion of air is a positive buoy in such localities, and often serves a double purpose of power generation and ventilation, as in the construction of the Mont Cenis tunnel. For surface work compressed air does seem to lack much in efficiency, but for mine purposes it is a certainty that electricity is an absolutely safe agent. The potentiality of a very little electric spark as an igniter of an explosive mixture of gas is well known, and must be a factor in a fiery mine. Where compressed air is used as a motive power distributed from a central station it might often be made very much more efficient by heating before use. There are many places where a fire of some kind is needed for other purposes, and from which there is much wasted heat which could be used to heat the compressed air, which would not then escape so exceedingly cold from its working cylinders. Otherwise it is difficult to see how an air-compressing system can be economically worked. It is not reasonably practicable to maintain compressed air at its initial temperature after compression, and hence the use of water jackets and jets to cool the air during compression, in order that it may not absorb the amount of power during the compressing process which it will do if not kept down to the external atmospheric temperature. It is this very serious difference between isothermal and adiabatic compression and expansion of air and other practically perfect gases which constitutes so large a part of the loss—a part which is almost inevitable.

It has been proposed for high pressures to compress in two operations—that is, by a compressor the reverse of the compound engine. By so doing the stresses on the parts are reduced; there is a less range of pressure in any one cylinder; more time is allowed for cooling during compression, and an intermediate receiver may be employed containing much cooling surface; the whole, in fact, being the converse of the compound engine, and the final or high-pressure cylinder having a less area for leakage, while the first cylinder catches any air which leaks back from the small cylinder, just as the second cylinder of the compound steam engine holds back the steam which leaks forward from the first cylinder.

Beyond such well-recognized mechanical aids to efficiency it does not seem possible to go, unless at the point of use there is heat available to add, so that the bulk of the air is increased before it is used, and an equal amount of duty gotten from a smaller volume of air. In a hot mine or heading this is to a small extent secured simply by absorption of heat in a bare pipe, but this is very small indeed. Air before using may be made as hot as will safely work in a cylinder, for it will be cool enough when discharged.

When it is remembered that air compressed to only about 60 pounds gauge pressure will be heated over 300° rise of temperature, it is plain that if cooled, before use, to the ordinary temperature, it will cool when expanded again to something far below the ordinary zero. Hence air used at 200° temperature will be exceedingly cold when exhausted from a working cylinder.

Some Machine Shop Devices.

BY L. C. SHARP.

Fig. 2 shows an apparatus for removing pistons. I see it around the shop here. I don't know where it comes from or anything about it, only it looks as though it might be a serviceable tool—a plug and a block and a key—its use will be plain by inspecting sketch.

Fig. 3 shows another way to bore a hole and a good way for measuring size holes on the horizontal boring-mill or milling machine.

Fig. 4. Every roundhouse machinist will recognize this job; please note the rope attached to the joint running through the head and down to the foot; this gives more pressure and makes a better job and saves time.

Fig. 5. No doubt many of our boys have stuck old screws to remove, containing slots which have no affinity for any kind of a screw-driver; well, you tell 'em to get right at 'em with this arrangement, and that old screw will get a surprise party tendered it.

Fig. 6. I was speculating the other day as to how much time could be saved by key-seating a driving axle right in the axle lathe on the center before it was removed from the lathe. It looks to me as though the scheme I send you might do this and save considerable over the old way of carting the axle about the shop, and quarters by dividers.

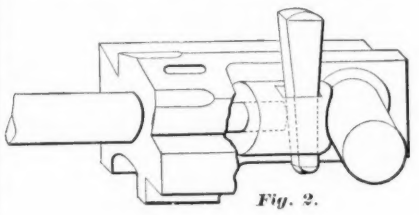


Fig. 2.

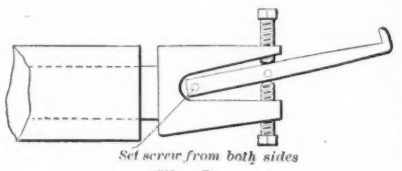
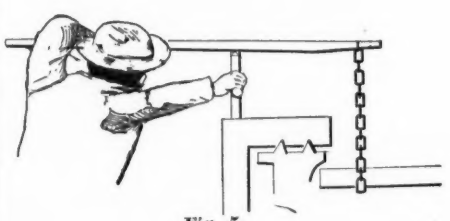


Fig. 3.



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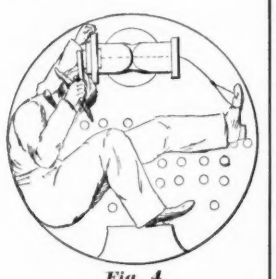

Fig. 4.

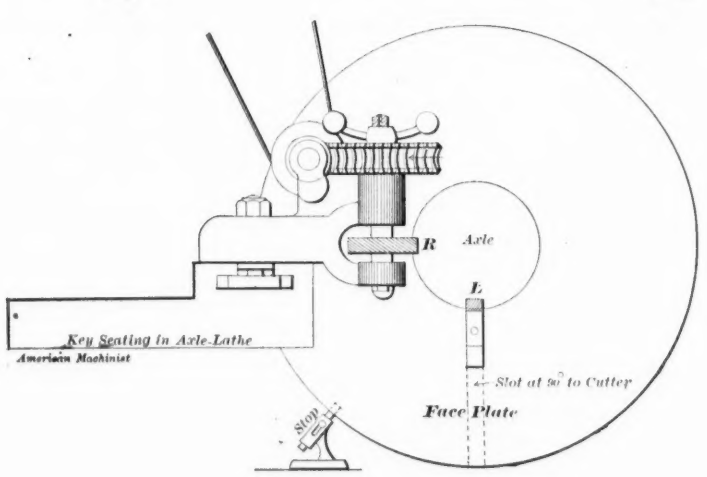

Fig. 6.

SOME MACHINE SHOP DEVICES.

One, perhaps two, building and loan associations in New Jersey have met trouble by taking up a "land improvement" scheme. Building and loan associations are mainly useful to wage earners, but sometimes men get at the head of them who have an axe of their own to grind, and then things are likely to go wrong. Men who can only put aside a few dollars a month should never consent that it be used for speculative purposes, where, as a matter of course, and at the best, success and failure stand opposed. The regular and legitimate business of building and loan associations is bound to be reasonably successful, and this should satisfy the investors. And they should insist that the associations are kept strictly to their legitimate purposes.

Natural Gas Scooped the Cyclone.

An amusing, if somewhat exciting incident occurred a few months ago in the new natural gas town of Elwood, Ind. The American Tin-plate Co. had just got a big natural gas "gusher" opened up, but not yet cased in, its roar being something tremendous to listen to, when an energetic Indiana cyclone came whirling along as if bent on painting the town red. It tore out the corner and end of the company's new rolling-mill building then in process of construction, and then looked round for something else to blow into fragments. Its eye lighted on the gas well, and in an instant the two were in collision. The conflict was as unequal as it was sudden. The cyclone went up and out, and was no more heard or seen. The gas well went on roaring as if nothing had happened, and, so far as it was concerned, nothing apparently had happened.

MANUFACTURES.

The Niles Tool Works, of Hamilton, O., has been changed into an incorporated company, under the name of the Niles Tool Works Co., with a capital stock of $1,000,000.

Hill, Clarke & Co., Boston, Mass., have issued a circular of the Rivett bench lathes, with attachments and illustrations of work done. The firm named are agents for the sale of these lathes.

The Mason Regulator Co., Boston, Mass., has recently received an order for 500 reducing valves from the Consolidated Car-heating Co. This is believed by the Mason Co. to be the largest order of the kind ever placed.

The Leetonia Forging Company, of Leetonia, O., has been formed, with a capital of $100,000, for the forging of iron and steel and manufacturing and dealing in products of iron and steel; incorporators, F. D. Childs, H. E. Green, S. H. Tolles, J. M. Henderson.

The Corning Steel Company is a new concern, which is to establish steel works at Hammond, Ind., for the manufacture of the steel bars and block plates required in the manufacture of tin plates. Mr. Corning, of this company, is from Peoria, Ill.

The Wright Steam Engine Works, Newburgh, N. Y., are occupying their new shops, which have been building for nearly two years. The machine shop is on the ground flour, and is 200x400 feet, equipped with modern tools. The capacity of the works has been doubled by the new shops.

The Rapid Unloader and Equipment Co. has been formed in New York City, with capital stock of $250,000, the object being the manufacture of improved machinery for the unloading of cars. J. H. and Arthur S. Drake and W. D. and Frank M. Stratton, all of 143 Liberty street, New York City, are the incorporators.

E. W. Bliss Co., Limited, Brooklyn, N. Y., has issued a new and very comprehensive catalogue of presses, drop hammers, shears, dies, etc. Since the last catalogue of this company was issued, there has been an amalgamation with the Stiles & Parker Press Company, and the present catalogue comprises the general and special tools made by both concerns.

The Buckeye Bell Foundry, Cincinnati, Ohio, issue a little pamphlet primarily relating to gong bells, etc., for street horse and electric cars, lodges, and for various other purposes, and secondarily it gives the presidential vote for several years, with a chance to write in estimates for the next election, a code of parliamentary rules, etc. It is a convenient little pamphlet to have.

The Skinner Chuck Company, New Britain, Conn., have secured patents on a new variety of chucks, and, as soon as the new machines ordered are received, will open another department for the manufacture of the new tools. The company are constantly adding to their works the best machinery to be obtained, to meet the demand for their goods.

The Jones Vestibule Sleeping Car Co., which was organized at Denver about three months ago, has recently purchased fifty acres of land within six miles of the city limits. The officers state that work will soon begin on the proposed car shops, but the first cars under the company's patents will be built in the East. The officers are: H. A. W. Tabor, president; Nathan A. Baker, vice-president; H M. Jones (patentee), general manager, and E. W Sebben, assistant general manager.

Norton Bros. have just added a carload of machine tools to the equipment of their machine shop at Maywood, Ill., including three Putnam lathes, 20, 24 and 28 inch respectively, a Whitcomb planer, Giant keyseater, Millers Falls power saw, and others, and have also considerably increased their working force of machinists, which will soon be further increased to 100 men, with corresponding increase in equipment. The shop is now running chiefly on machines for making tin plates.

Redfield & Toense, 265 Dearborn street, Chicago, Ill., write us: We are doing considerable in the line of machine designing at present. Among the work of this class on hand now is a five mold dry press brick machine (for the Simpson Brick Press Company) that is to be built expressly for exhibition in the World's Fair. We are also designing a special wire-twisting machine for the De Kalb Fence Company, De Kalb, Ill., and some new sawmill machinery for Spangenberg, Pendleton & Co., Warren, Ohio, besides several special machines for local parties.

The National Chuck Manufacturing Company, Mt. Vernon, N. Y., write us to correct a misapprehension which has arisen as to the liabilities of their predecessors in business. The letter is from Mr. Wm. Whitlock, the president and the treasurer of the present company, and fully explains the situation. It is as follows: Our attention has been called to the notice of filing of a judgment against the National Chuck and Machine Company, our predecessors. As this is likely to cause some comment, we should esteem it a favor if you could note in your paper that this judgment in no way affects this company, which is controlled by Mr. Wm. Whitlock, who bought the plant and effects from the receiver of the National Chuck Machine Company, and is conducting the business under the above style—National Chuck Manufacturing Company. We may add as a news item, that we are moving our factory to 132d street and Park avenue, New York City, where we shall be in operation in a few days, and with improved facilities, ready to fill all orders promptly.

Machinists' Supplies and Iron.

NEW YORK, June 29, 1892.

Iron—American Pig—We quote Standard Northern brands, No. 1 Foundry, $15.50 to $16; No. 2, $14.75 to $15; Gray Forge, $13.50 to $14. Southern brands of good quality are obtainable at $14.75 to $15.50 for No. 1 Foundry; $13.75 to $14.50 for No. 2; and $12.75 to $13.50 for Gray Forge.

Scotch Pig—Coltness is quoted at $21; and $20.25 for Eglington.

Antimony—The market continues to decline.

We quote Hallett's, 10¾c. to 11c.; Cookson's, 14c. to 14⅛c.; and L. X., 12½c. to 12⅝c.

Copper—The market is weak. Lake Copper can be had at 11.70c. to 12c. Casting Copper is held at 11⅛c. to 11¼c.

Lead—Smelters are disposed to be firmer in their views, on account of the shortness of supply. It is said that 300 tons pig lead have been sold at 4.15c.; that price is still bid, and 4.25c. asked. There is little confidence in the present prices.

Lard Oil—The market is quoted at 58c. to 59c. for Prime City. Western on spot is quoted at 57c. to 58c.

Spelter—The market is dull at 4.80c. to 4.85c. asked, with a tendency towards lower prices.

Tin—Lack of faith in the present values is causing easier feelings. Sales have been 50 tons June at 21.25c.; 50 tons spot at 21.20c; and 60 tons July at 21.20c.

✻WANTED✻

"Situation and Help" Advertisements only inserted under this head. Rate 80 cents a line for each insertion. Seven words make a line, and the address as desired to appear should be included. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Wanted—Foundry foreman, to take charge of foundry doing general work; melting, ten to fifteen tons daily. Address Box 22, AM. MACHINIST.

Wanted—A good Cornet B flat or Clarionet player; machinist or floor hand by trade. J. T. Waters, 198 S. East Street, Massillon, Ohio.

Wanted—Position by mech. draftsman, graduate Royal Polytechnical Institute, Sweden. Address BOX 24, AMERICAN MACHINIST.

Wanted—A draftsman. One who can draw well in perspective and shade effectively. A 1st-class opening for a good man. A. Mugford, Hartford, Ct.

Wanted—A comp. mach. who thoroughly understands spec. automatic wire-bend'g & form'g mach., to take full charge of same. Wire, AM. MACH.

Wanted—Five first class lathe hands, and five floor or vise hands. Wages $2.25 to $2.75 per day; steady work. Sioux City Engine Works, Sioux City, Iowa.

Young man would like position with a manufacturing concern, with a chance of advancement; familiar with drawing room, machine shop and foundry practice. Assistant, AMERICAN MACHINIST.

Engineer and draftsman, experienced in the designing of machinery, with experience here and abroad, desires suitable position. Lately employed as foreman. Iron City, AMERICAN MACHINIST.

Wanted—Three good machinists and vise and floor men; long-time job; light work; two hours' ride from Chicago. Address at once, with references and full particulars, Box H., Michigan City, Ind.

Wanted—Experienced draftsman for general designing; permanent situation to right man; give full particulars as to experience, and salary wanted. Address Filer & Stowell Co., Milwaukee, Wis.

Wanted—Situation as superintendent or foreman of foundry; 15 years' experience on marine and heavy castings of every description; best of references given. Address Box 25, AM. MACHINIST.

Mechanical engineer, with shop and drafting room experience, wants situation as designer draftsman or foreman; in a small machine shop preferred. Address G. G., AMERICAN MACHINIST.

A young man, technically educated, reared in shops, with some exp. as a draftsman, and lately a teacher, desires pos. as foreman, manager, or erecting engineer. L., Box 65, Anamosa, Ia.

Wanted—One or two 1st-class draftsmen, who are familiar with light machinery and tool work, such as gun and sewing machine tools. Address Box 29, Providence, R. I.

Wanted—Position as foreman machinist, by a 1st-class man; credentials are first-class in turning out first-class work with economy and dispatch; experience in marine, stationary and pumping machinery. Address Box 26, AMERICAN MACHINIST.

A young graduate, mech. eng., having four years' prac. exp., is open to engagement. The advertiser is well posted on indicator practice, foundations, & the installation of mach'y & power plants; a reliable draftsman, quick at detailing; also conversant with modern methods of duplicating parts economically. Position, rather than salary, desired. Excellent references. Progressive, AM. MACHINIST.

✣ MISCELLANEOUS WANTS ✣

Advertisements will be inserted under this head at 25 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Wall Drills complete, $25. S. M. York, Clev'd, O.

Auto. Steam Flue Cleaners. Kelley Co., Erie, Pa.

Cheap 2d-hd lathes & planers. S. M. York, Clev'd, O.

Presses, Wire Form'g Mchy. Am. Tool Wks, Clev, O.

Best Bolt Header in the world for $50. Address C. H. Baush & Sons, Holyoke, Mass.

Wanted--Specialties to build for the Southern trade. Bluefield Iron Works, Bluefield, W. Va.

Engines, special and gen. mach'y designed; ideas developed. A. W. Jacobi, 136 Liberty St., N. Y.

Special machinery designed and built. C. F. Langston & Co., 70 N. 4th St., Philadelphia.

Working drawings of mach'y furnished on short notice by practical draftsman. P. D. Q., AM. MACH.

World's Fair Exhibitors ATTENTION.

Do you desire the services of a reliable company to receive, install and superintend your exhibit during the World's Columbian Exposition? We can save you money. Unexceptional references. Write for pamphlet and particulars.
CHICAGO COMMERCIAL COMPANY,
501, 502, 503 Home Insurance Bldg., Chicago.

Hart's Adjustable "Duplex" Die Stocks For Bolts.

AS USED BY Machinists, Model Makers, Blacksmiths, &c,
HART M'F'G CO.
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Send for Illus. Circular.

Experimental Work of every Description,

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Send for Circular of our SENSITIVE KNEE DRILL.
BRADY M'F'G. CO. 83 Washington St., BROOKLYN, N. Y.

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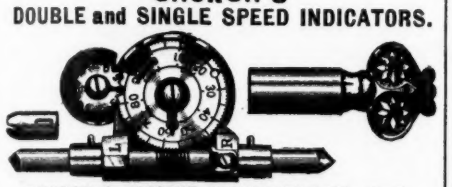
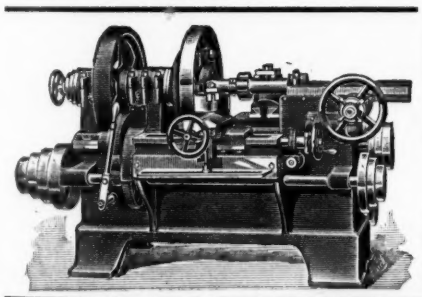
CHURCH'S DOUBLE and SINGLE SPEED INDICATORS.



CHURCH & SLEIGHT, 109 FULTON ST., N. Y.



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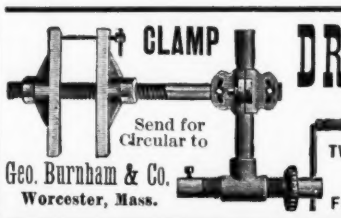
Special facilities for Accurate Work.
Bevel Gears cut theoretically correct.

CLAMP DRILLS



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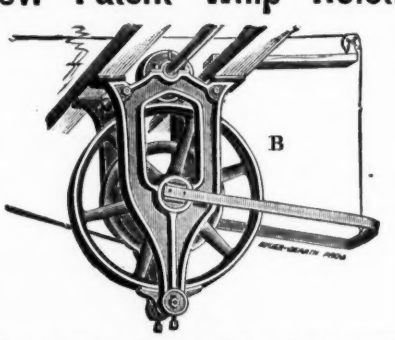

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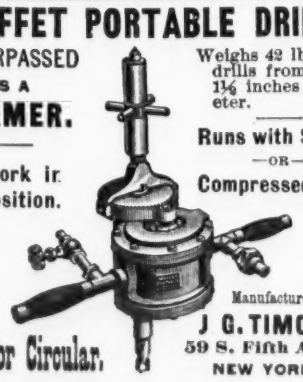

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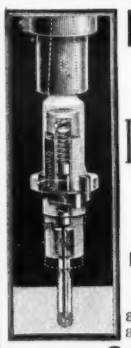

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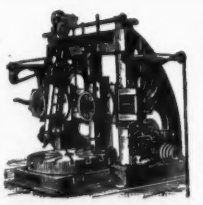

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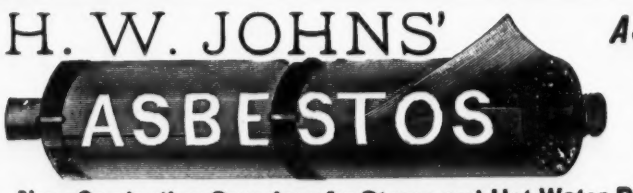

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30 do	14 do	do		do
27 do	16 do	do		
24 do	12 do	do		Fifield
24 do	12 do	do		Fitchburg
24 do	12 do	do		Flather
23 do	10 do	New Pattern		Fifield
23 do	12 do	do		do
22 do	12 do	New		Blaisdell
22 do	8 do	do		Flather
22 do	10 do	do		do
20 do	8 do	do		do
20 do	10 do	do		do
18 do	8 do	do		do
18 do	10 do	do		do
18 do	8 do	do		Blaisdell
18 do	16 do	do		do
16 do	6 do	do		Flather
16 do	6 do	do		Blaisdell
15 do	6 do	do		Flather
14 do	6 do	do		do
14 do	6 do	do		Blaisdell
12 do	6 do	do		do

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42 in. wide, 42 in. high, 12 ft. long, 2 heads			Gleason
36 do	36 do	8 do	Pease
30 do	30 do	8 do	do
30 do	30 do	8 do	Whitcomb
30 do	30 do	8 do	Flather
26 do	26 do	6 do	do
24 do	24 do	6 do	do
24 do	24 do	6 do	Whitcomb
22 do	22 do	5 do	do
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46 in. x33 in. x30 ft.	do	2 do			
42 in. x44 in. x 8 ft.	do	1 do			
39 in. x36 in. x12 ft.	do	1 do			
36 in. x36 in. x10 ft.	do	1 do			
30 in. x30 in. x7 & 8 ft.	do	1 do			
26 in. x 6 in. x8 ft.	do	1 do			
25 in. x24 in. x6 ft.	do	1 do			
22 in. x21 in. x5 ft.	do	1 do			
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42 in. x17 ft.	do	Al	do	do	
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28 in. x12, 14, 16, 18 ft.	do	do	do	do	
21 in. x10, 12 ft.	do	do	do	do	
20 in. x 7½ & 8 ft.	do	2d Hand	do	do	
18 in. x 6, 7 & 8 ft.	do	New & do	do	do	
17 in. x 8 ft.	do	do	do	do	
16 in. x 6 & 8 ft.	do	do	do	do	
15 in. x 6 & 8 ft.	do	do	do	do	
14 in. x 6 ft.	do	do	do	do	

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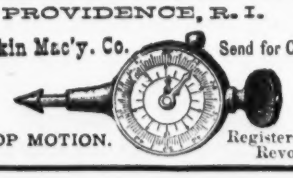

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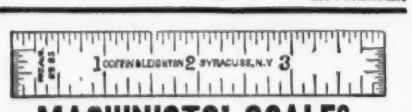

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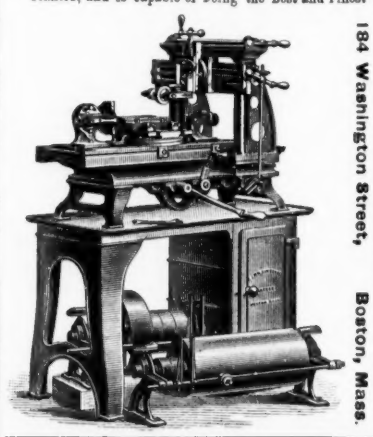

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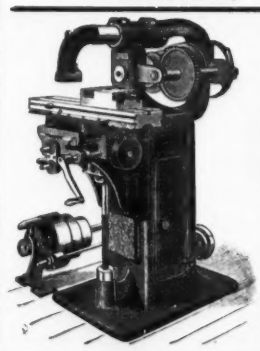

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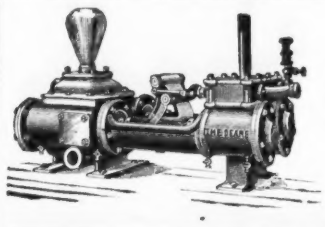

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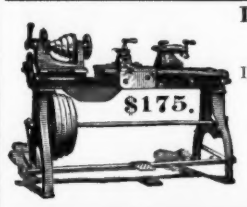

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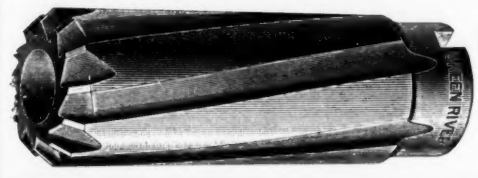

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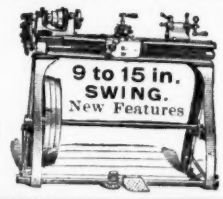

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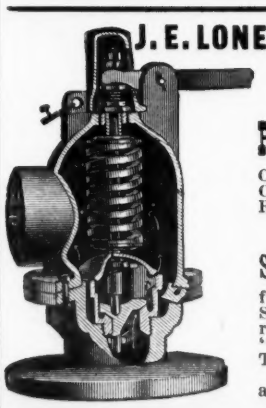

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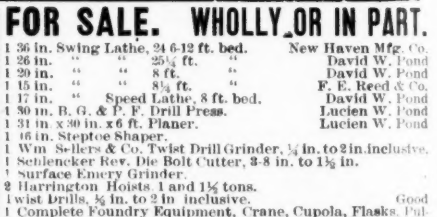

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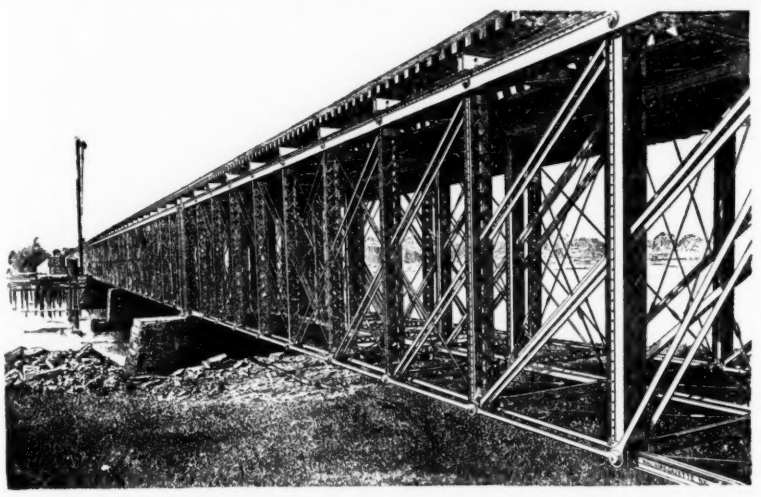

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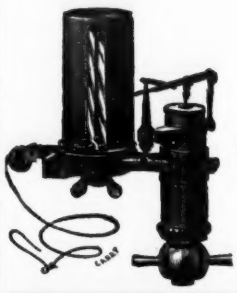

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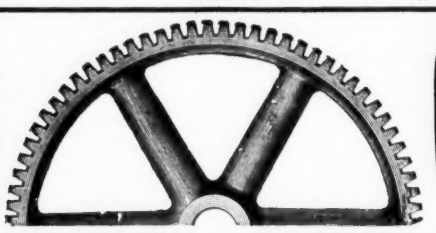

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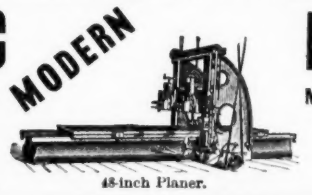

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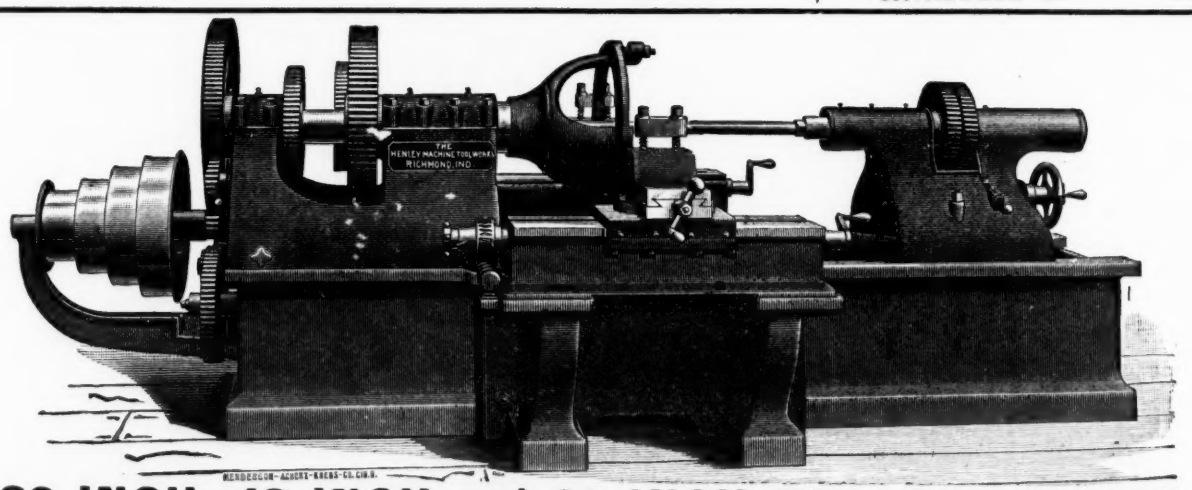

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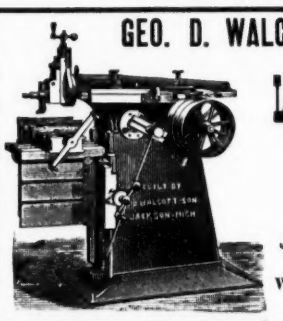

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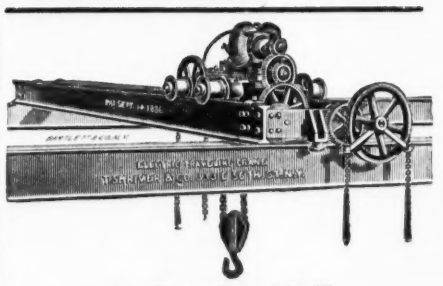

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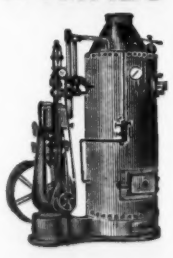

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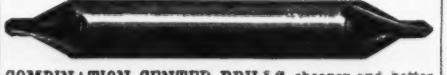

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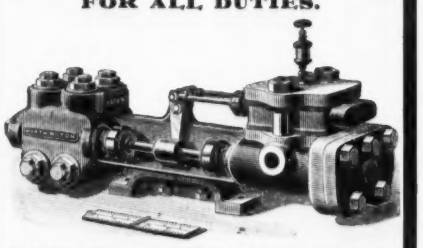

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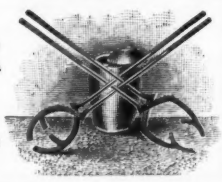

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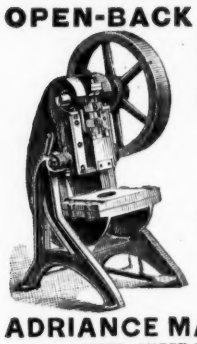

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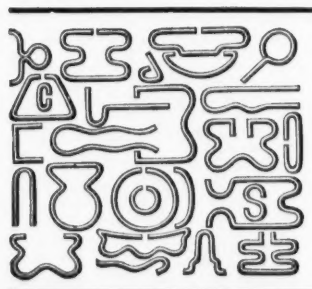

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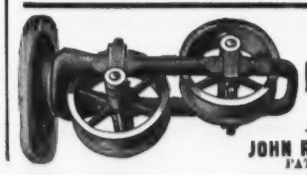

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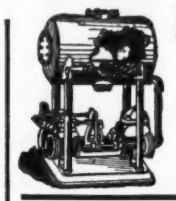

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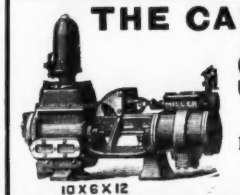

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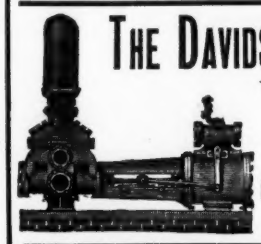

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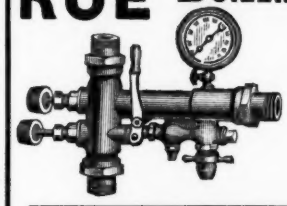

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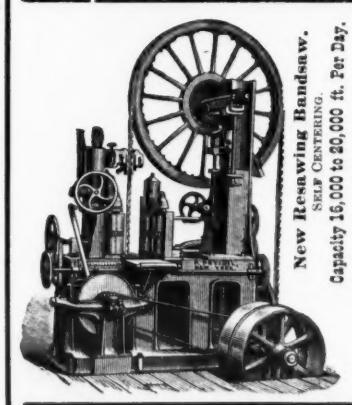

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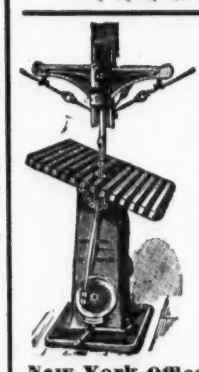

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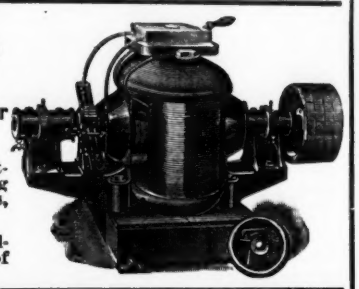

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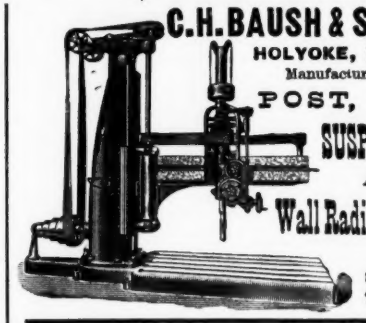

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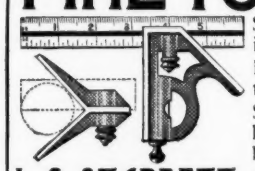

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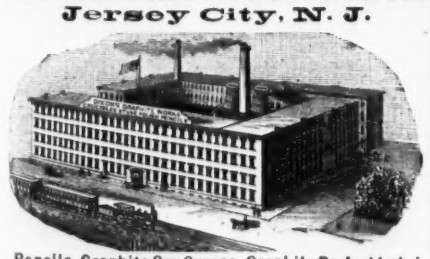

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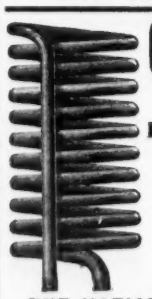

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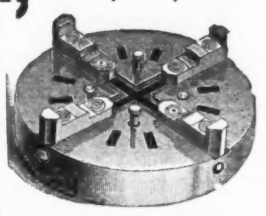

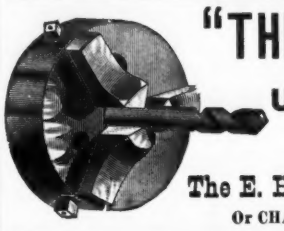

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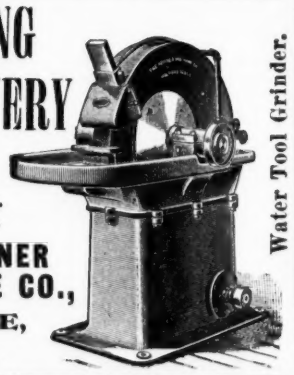

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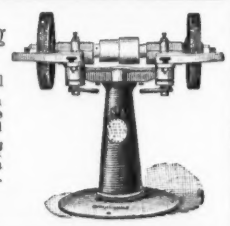

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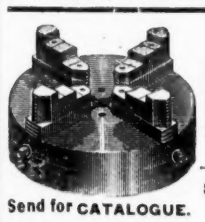

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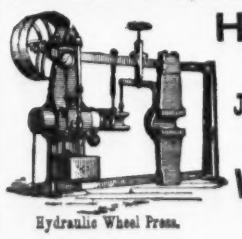

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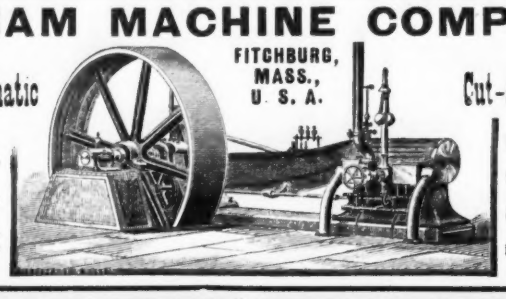

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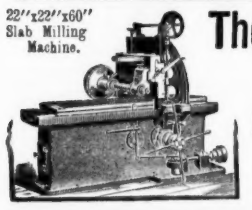

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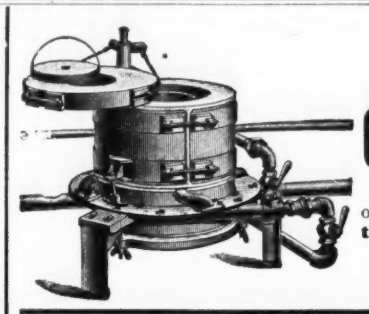

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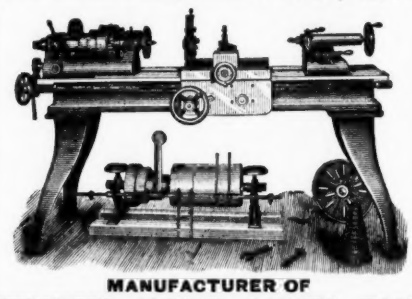

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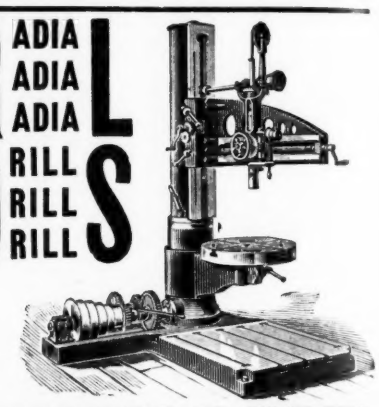

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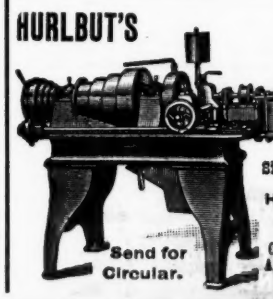

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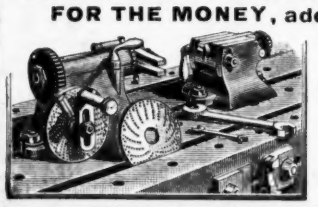

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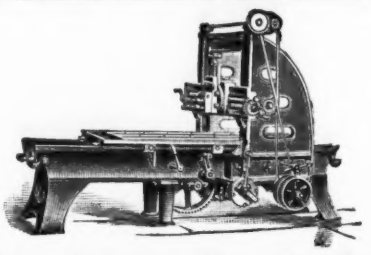

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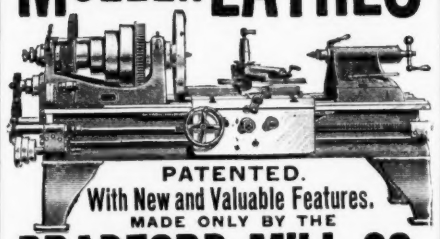

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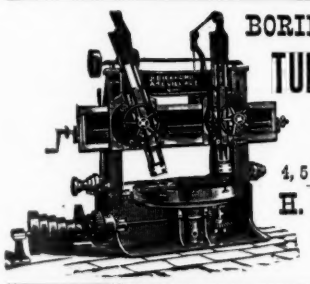

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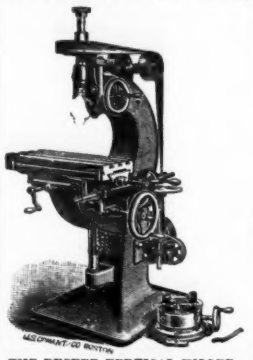

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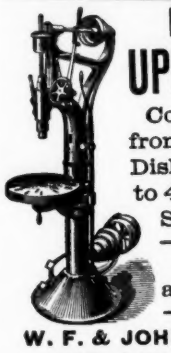

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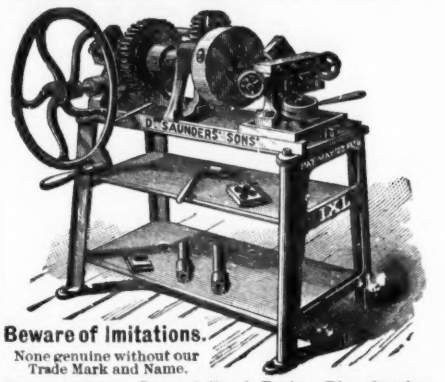

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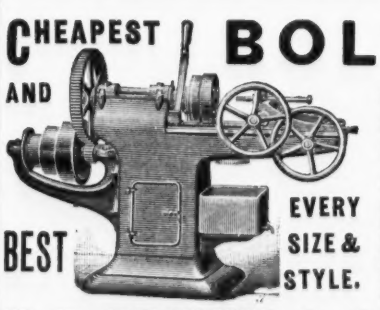

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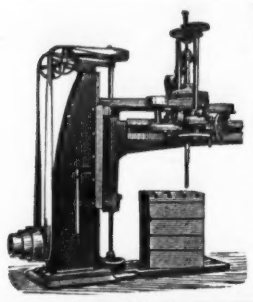
THE LARGEST ORDER
for Reducing Valves, ever received, was placed last week, by the Consolidated Car-Heating Co., with the **MASON REGULATOR CO. OF BOSTON.**
It was for 500 Locomotive Reducing Valves. What inference do you draw from this?



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Operated by Electricity, Shafts or Independent Engines.
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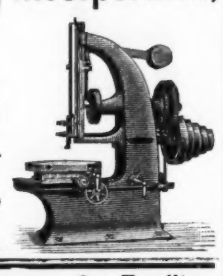
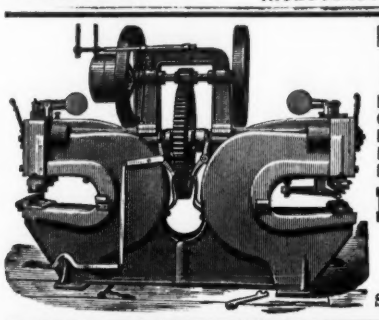
INJECTORS FOR ALL CLASSES OF BOILERS.





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Double, Single, Angle-Bar, Gang, Horizontal, Twin, Boiler, Spacing, Gate, Multiple, Belt and Steam-Driven
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OVER 300 SIZES.
ALSO
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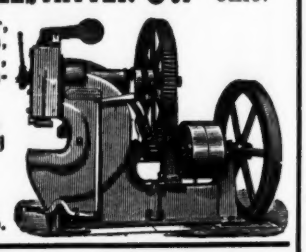
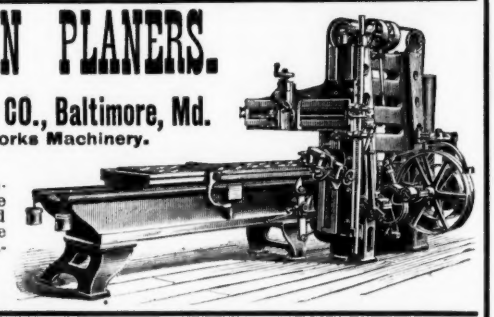


THE OPEN SIDE IRON PLANERS.
THE DETRICK & HARVEY MACHINE CO., Baltimore, Md.
OREGON IRON WORKS, Gas Works Machinery.

NEW YORK, Oct. 30, 1891.

GENTLEMEN: Replying to your letter of October 27th, we take pleasure in stating that we have one of your Open Side Planers in use, and one Open Side Extension Planer. Both of these machines give entire satisfaction, and are first-class machines in every particular.

Yours truly,
JAMES R. FLOYD & SONS.



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Cutting from 1-8 in. to 6 in. diameter.
Also SEPARATE HEADS and DIES.
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STUART'S PATENT IMPROVED WEDGE COUPLING
SENT ON TRIAL.
Uses neither PINS nor KEYS.
Can be attached or removed in a few seconds without injury to shaft or coupling.
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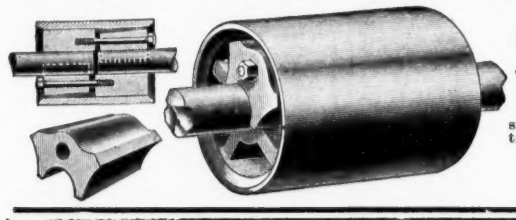

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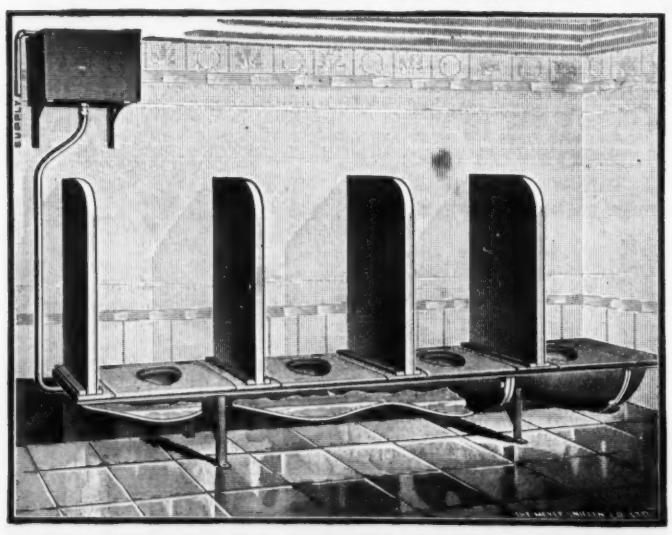

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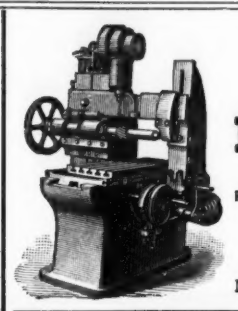

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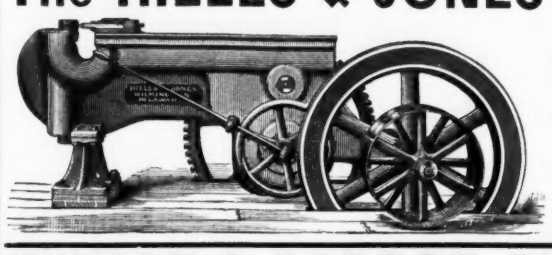

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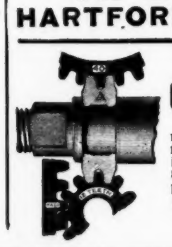

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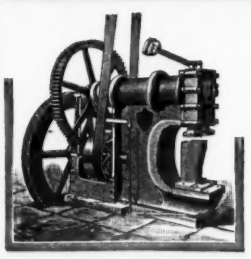

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MANUFACTURED BY
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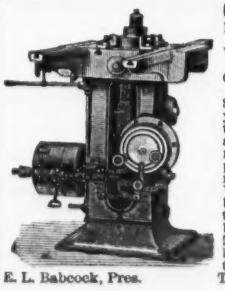
If the work is heavy and too large to be placed on machine it can be detached from stand and used as portable machine.



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Rack-Cutting Attachment
Key-Making Machines
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THE LEADER.
With recent patented improvements, we guarantee to do the following class of work.
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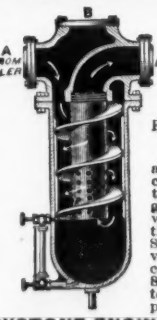

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For Supplying Clean and Dry Steam to Engines, Dry Houses, etc.
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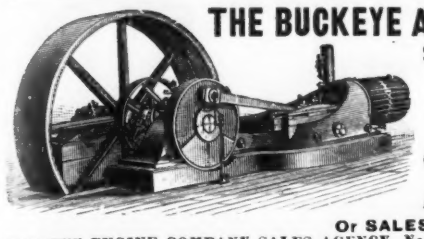

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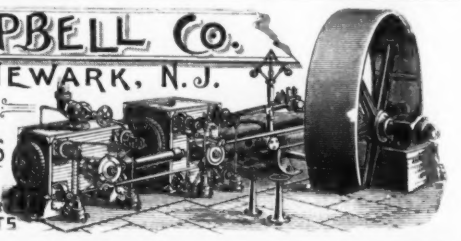

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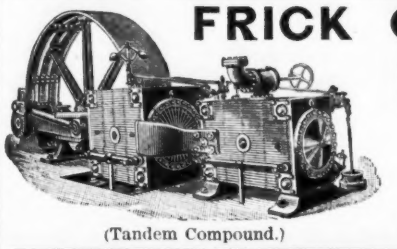

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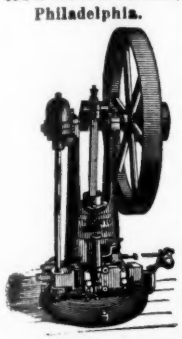

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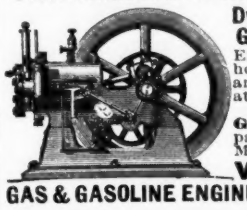

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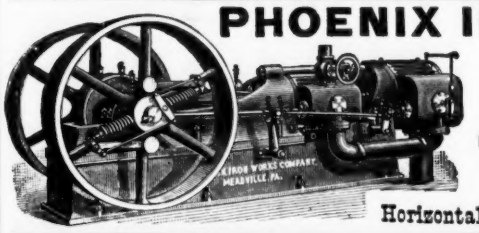

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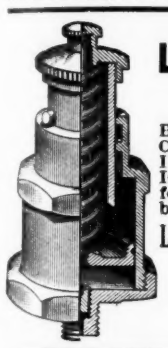

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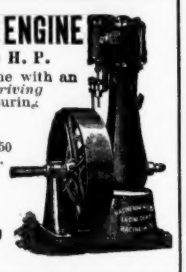

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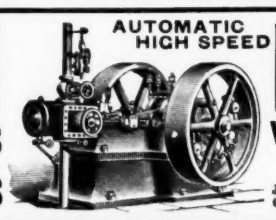

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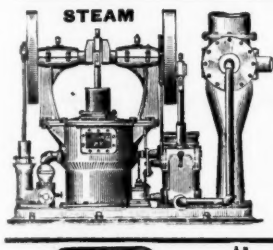

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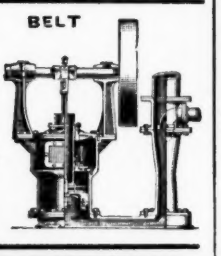

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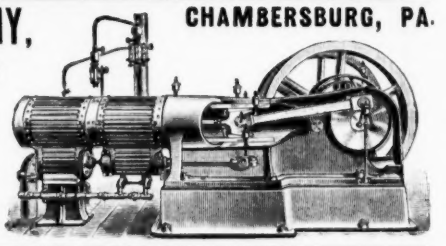

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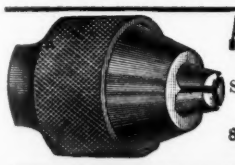

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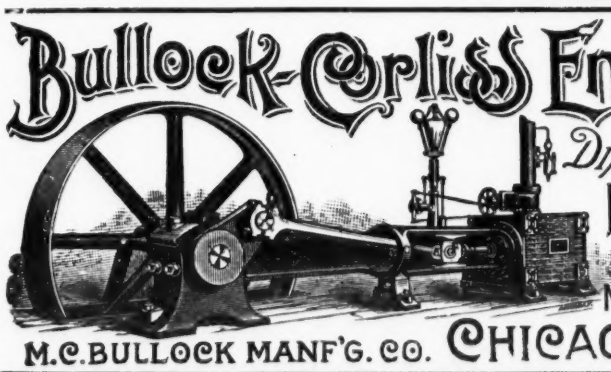

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MINING MACHINERY.

M.C. BULLOCK MANF'G. CO. CHICAGO, U.S.A.

PRESSES, DIES AND OTHER SHEET-METAL TOOLS

FERRACUTE MACHINE CO. BRIDGETON, N. JERSEY, U.S.A.

NEW AND SECOND-HAND MACHINERY (In Stock.)

Engine Lathe,	66 in. x 24 ft.,	Heavy Pattern, for facing and boring. Low price.
"	60 in. x 20 ft.,	Heavy Pattern. " "
"	34 in. x 11 ft.	" " " "
"	20 in. x 10 ft.	Ames, C'p'd Rest and Cross Feed, special reverse feature, complete. At order.
"	20 in. x 8 ft.	Perkins, Hollow Spindle and Cross Feed complete. At order.
"	24 in. x 12 ft.,	Fitchburg, C'p'd Rest, Cross fd.
"	18 in. x 8 ft.,	C'p'd Rest, New Haven, complete.
"	16 in. x 6 ft.,	Lathe and Morse. Good order.
"	14 in. x 6 ft.,	Ashton, Hand. " "
Planer,	17 in. x 4 ft.,	Whitcomb modern style. At order.
"	24 in. x 8 ft.,	Lathe & Morse modern style. " "
"	42 in. x 42 in. x 8 ft.,	Powell Planer Co.'s, latest pat. At.
"	48 in. x 10 ft.,	modern style. Good order.
Upright Drill,	24 in.,	Ames, complete. " "
Radial	"	5 ft. Arm, B'k G'd, Auto. Feed, Niles. At order.
Shaper,	9 in.,	Crank Motion, Hewes & Phillips. Good order.
"	15 in.,	" " Gould & Eberhardt. At order.
"	14 in.,	Trav. Head, Fitchburg. " "

Slotting Machine, 9 in. stroke, modern, complete. Good order.
Pipe Machine, 4 in., with full set Dies Morris & Tasker's
Screw Machines 15-16, 1 3-8 and 2 1-8 in. holes, Brown & Sharpe and Jones & Lamson makes, with Tools Good order.
Boiler Bending Rolls, 6 ft., Good Design, Heavy and Powerful, complete. At order, low price.

IMPROVED NEW TOOLS.

Engine Lathes, 14 to 48 in. Swing. Fitchburg, Hendey, Ames and Perkins makes. Double and Triple Gear.
Drills, 20 to 32 in. Prentice Bros. makers.
Planers, 24 to 42 in. Powell, Fitchburg, makers.
Boiler Rolls, new patterns, 8 and 10 ft. long.

BOILER AND BRIDGE TOOLS.

Riveting Machine, 60 in., for bridge and boiler work, modern style with full hoisting outfit. Good order.
Boiler Rolls, 6 ft., very powerful. At order.
" " 8 and 10 ft., improved style. New.

J. J. McCABE,

SUCCESSOR TO E. P. BULLARD'S N.Y. Mach'y Warerooms.

68 Cortlandt Street, NEW YORK.

MARKING MACHINE,

For rolling trade-marks on flat or round Iron or Steel surfaces.
Used by Cutlery Pistol, Twist Drill, Wrench, and many other mfrs.
200 in use.
Read up.
Catalogue "B" free.

DWIGHT SLATE MACHINE CO.,

HARTFORD, CONN.

MARK YOUR TOOLS WITH A STEEL STAMP.

OHIO THE OHIO STAMP WKS 123 CHAMPLAIN ST. CLEVELAND OHIO.

SEND FOR PRICE LIST NO. 4.

GREASE CUPS ARE IN GREAT DEMAND.

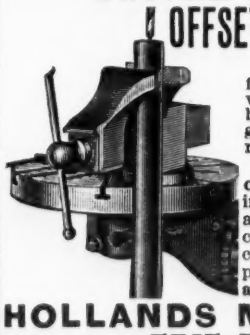
Fig. 318.

If you want the best, investigate Lunkenheimer's; they will please you. **Figure 318** is an automatic cup and can be adjusted to any desired feed. **Figure 319** is not automatic, but one turn of the cap will supply enough grease for several days. **Simple, Practical, Durable, Efficient,** and giving perfect satisfaction wherever they are used. Try them and you will say so too. Send for catalogue of high grade valves, lubricators, oil and grease cups, etc. Lunkenheimer's Specialties are supplied by dealers throughout the United States.

THE LUNKENHEIMER BRASS MFG. CO., Cincinnati, O., U. S. A.

Fig. 319.

SWIVEL BASE. 4 OFFSET JAW VISE.



Specially adapted for drill press work where chucks cannot be used, and equally good for special or regular bench work.

Send for catalogue of full line of the most improved designed, and best finished machinists', plumbers', coach makers' and pattern makers' vises and small tools.

HOLLANDS MFG. CO.,

ERIE, PA.

STEEL CASTINGS

FROM 1-4 TO 15,000 LBS. WEIGHT.

True to pattern, sound, solid, free from blow-holes and of great strength.

Stronger and more durable than iron forgings in any position or for any service whatever.

60,000 CRANK SHAFTS and 50,000 GEAR WHEELS of this steel now running prove this.

Crossheads, Rockers, Piston-Heads, etc., for Locomotives.

STEEL CASTINGS of every description.

Send for Circulars and prices to

CHESTER STEEL CASTINGS CO.,

Works, Chester, Pa. Office 407 Library St., Philadelphia, Pa.

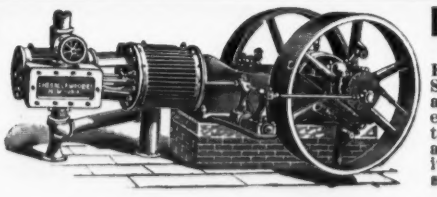
THE IMPROVED BALL ENGINE.

AS BUILT BY

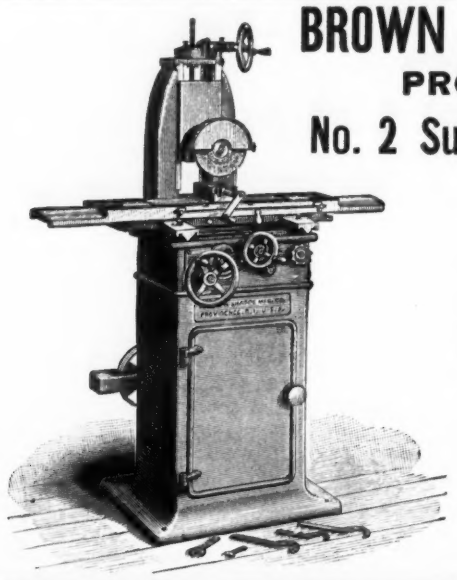
The Ball & Wood Co.

OFFICE,

15 Cortlandt Street, NEW YORK.



Is superior in **DESIGN, FINISH** and **WORKMANSHIP.** In **REGULATION** and **ECONOMY** it has no equal. Built with new tools from new patterns and after long experience, it marks the latest step in steam engineering.



BROWN & SHARPE MFG. CO.
PROVIDENCE, R. I.

No. 2 Surface Grinding Machine.

The design of our machines is constantly being improved.

The No. 2 Surface Grinder is heavier and more rigid than earlier machines. The bearings are longer, the feed works better protected from dust, and the reversing mechanisms improved. Fine adjustments can be easily obtained. The table is 18″ long, 6″ wide.

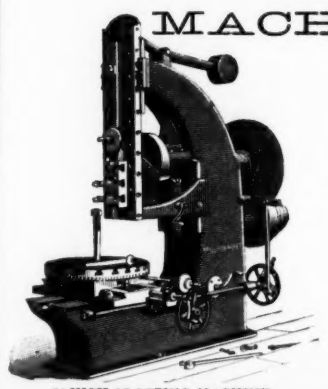
Weight of the machine, **1,500** lbs.

Machine Tools on exhibition at 23 South Canal St., Chicago, Ill.

S. A. SMITH, Western Representative.

NILES TOOL WORKS,
HAMILTON, OHIO.

MACHINE TOOLS.



14-INCH SLOTTING MACHINE.

SLOTTING MACHINES.

In sizes from 6½-inch stroke to 54-inch stroke. Cutter-bar counterbalanced and provided with quick return motion. Feeds are longitudinal, transverse and circular, all automatic.

Special Iron and Steel-working machinery for all classes of machine shops.

Correspondence solicited.

NEW YORK, 136 & 138 LIBERTY ST. CHICAGO, PHENIX BLDG. PITTSBURGH, LEWIS BLOCK.

JENKINS DISCS FOR HIGH STEAM PRESSURE.

If you have trouble with Discs, write us. We can furnish Discs, or Valves, that will be satisfactory. There are dealers who sell Discs as "Jenkins," when they know they are not genuine.

JENKINS BROS.' VALVES ARE STAMPED WITH TRADE MARK.

JENKINS BROS. 71 JOHN STREET, N. Y. 105 MILK STREET, BOSTON. 21 NORTH FIFTH ST., PHILA. 31 & 33 N. CANAL ST., CHICAGO.

CRANES
THE YALE & TOWNE MFG CO.
STAMFORD CONN
NEW YORK CHICAGO PHILA BOSTON

THEY GET THE REWARD.

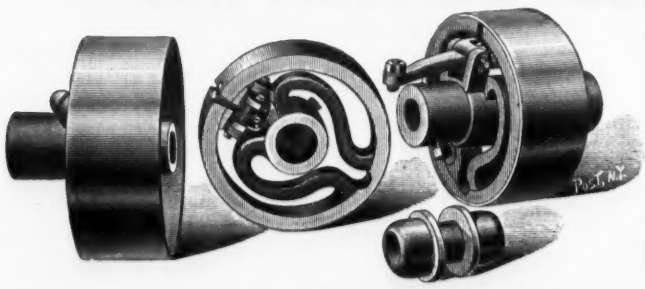
From among the large number of contestants for our Rewards for the largest day's work done on one of our Standard Engine Lathes, the following workmen have secured the prizes.

$50.00—George Kern, of Erie City Iron Works, Erie, Pa.
25.00—George Kennedy, of Wm. Deering & Co., Chicago, Ill.
15.00—Ernst Robert Fischer, of J. E. Reinecker's Works, Chemnitz, Germany.
10.00—H. C. Kirkpatrick, of Eagle Iron Works, Meadville, Pa.
10.00—John A. Grant, of Lloyd-Booth Co., Youngstown, Ohio.
10.00—C. H. Stall, of Harmon Machine Works, Watertown, N. Y.
10.00—Owen McCloskey, of American Hat Machine Co., Newark, N. J.
10.00—Sam'l J. Sill, of Holyoke Hydrant & Iron Works, Holyoke, Mass.
10.00—Carl Gross, of The Darling Pump Co., Williamsport, Pa.

THE LODGE & DAVIS MACHINE TOOL CO.
WORKS: CINCINNATI, OHIO.

See advertisement, Page 16.

NEW FRICTION PULLEY.



NOW USED ON OUR SCREW AND Milling Machines.

IN STOCK.

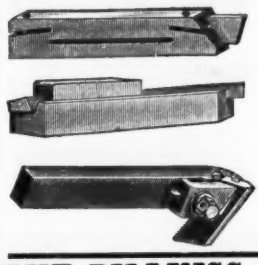
Diameter.	Face.	Hole.	Price Per Pair.	Price Each.	Diameter.	Face.	Hole.	Price Per Pair.	Price Each.
6	1¼	1 1-16	$ 7.50	$ 4.50	12	3½	1 7-16	$14.00	$ 7.50
8	2½	1 3-16	8.00	4.50	14	4	1 7-16	16.00	8.50
8	3	1 7-16	10.00	5.50	16	4	1 11-16	18.00	10.00
10	3	1 7-16	12.00	6.50					

THESE PRICES INCLUDE THE NECESSARY THIMBLE, FORK AND COLLARS.

They are self-oiling, and balanced. Are running successfully at 700 revolutions per minute.

THE CARVIN MACHINE CO.,
LAIGHT AND CANAL STS., - - - NEW YORK.

THE PRATT & WHITNEY CO.
HARTFORD, CONN., U. S. A.

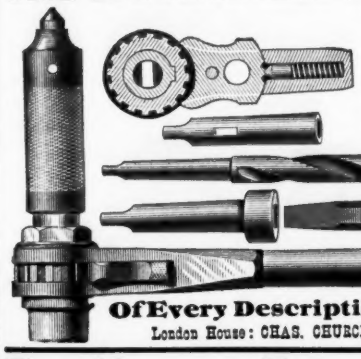


Ask trial of **Holders with Inserted Cutters,** in Lathes and Planers for Turning, Cutting Off, Threading, Shaping, and Boring Metals. The cutters are inexpensive and may be sharpened by grinding without changing the form.

Milling Cutters, in variety, carried in stock and made to order.

CIRCULARS AND PRICES FURNISHED UPON APPLICATION.

THE BILLINGS AND SPENCER CO., HARTFORD, CT., U. S. A.



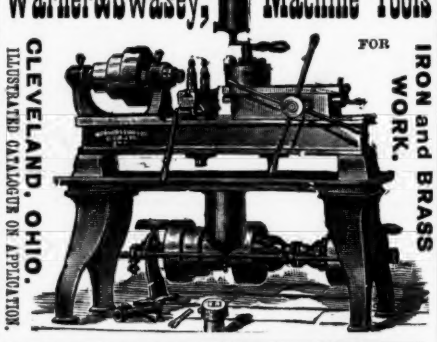
MANUFACTURERS OF
BILLINGS' PATENT DOUBLE-ACTING RATCHET DRILL,
For Morse Taper Shank Drills.

Packer Ratchet Drills,
Packer Boiler Ratchet Drills,
Packer Auger Ratchet Drills,

DROP FORGINGS
Of Every Description, of Bronze, Copper, Iron and Steel.

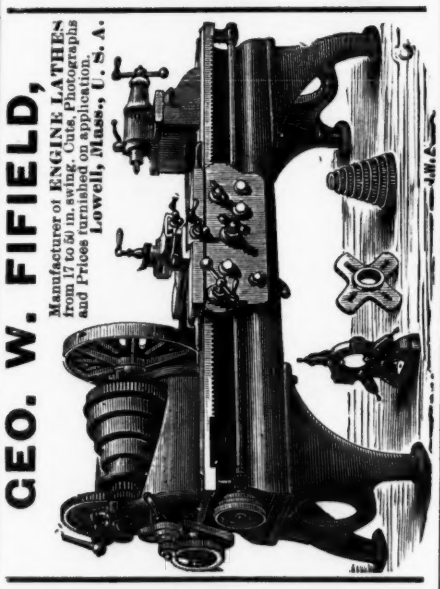
London House: CHAS. CHURCHILL & CO., Limited, 21 Cross Street, Finsbury, London, E. C., England.

Warner & Swasey, Machine Tools
FOR IRON and BRASS WORK.



CLEVELAND, OHIO.
ILLUSTRATED CATALOGUE ON APPLICATION.

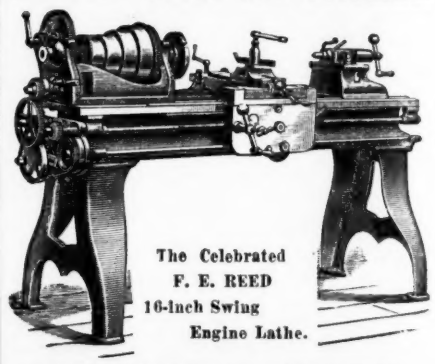
GEO. W. FIFIELD,



Manufacturer of ENGINE LATHES from 17 to 50 in. swing. Cuts, Photographs and Prices furnished on application.
Lowell, Mass., U. S. A.

Key-Seating Machines and 20 in. Drills
A SPECIALTY.
SEND FOR LIST OF
New and Second-Hand
Lathes, Planers, Drills,
or anything in Machinists' Tools or Supplies.
W. P. DAVIS,
Rochester, N. Y.

MANNING, MAXWELL & MOORE,
Manufacturers and Dealers in all kinds of RAILWAY and MACHINISTS' **TOOLS AND SUPPLIES.**



The Celebrated F. E. REED 16-inch Swing Engine Lathe.

111-113 LIBERTY ST., NEW YORK.

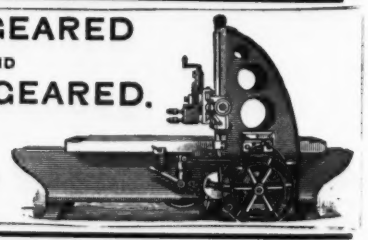
We carry the largest line of Tools and Supplies in the City.

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO.
HARTFORD, CONN.

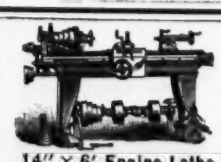
J. M. ALLEN PRESIDENT.
WM. B. FRANKLIN, VICE-PRESIDENT.
F. B. ALLEN, SECOND VICE-PRESIDENT.
J. B. PIERCE, SECRETARY & TREASURER.

Gear Wheels and Gear Cutting.
Grant's Gear Book for 1892, 15 Cents.
Lexington Gear Works,
Lexington, Mass.

PLANERS
SPUR GEARED AND SPIRAL GEARED.

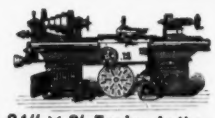


MANUFACTURED BY
The G. A. GRAY CO.,
479 Sycamore St., CINCINNATI, O.



14″ × 6′ Engine Lathe.

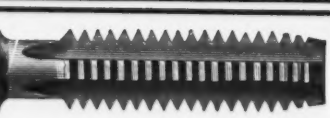
16″ × 6′ Engine Lathe.



21″ × 8′ Engine Lathe.

THE HENDEY MACHINE CO. SEND FOR OUR CATALOGUE
MANUFACTURERS OF MACHINE TOOLS.
TORRINGTON, CONN.
CHAS. CHURCHILL & CO., LTD. AGTS. 21 CROSS ST., FINSBURY, LONDON, ENG.

J.M. CARPENTER PAWTUCKET, R.I.



Manufacturer —of— **TAPS & DIES**